INSTRUCTION MANUAL

FT-301

YAESU MUSEN CO., LTD.

TOKYO JAPAN.

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GETTING ACQUAINTED WITH YOUR YAESU FT-301

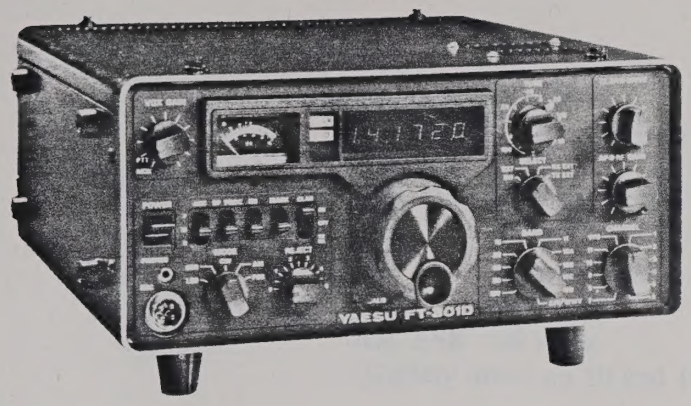
After you unpack the unit, spend some time with this manual so that you have a good understanding of what each switch, knob and control is for.

It will make your operation easier, possibly keep you from accidentally damaging something, and give you the basic information you need to put the unit to work in the way that will provide you maximum pleasure.

Solid state equipment has enormous reliability. The statisticians have not yet developed life expectancies of many components simply because "end-of-life" cannot be established. Transistors and IC's just keep on going IF THE RATINGS ARE NOT EXCEEDED. If you observe some basic precautions, the FT-301 will provide you with many years of reliable operation.

This manual is revised for the units produced starting with Lot No. 003 and the lots produced subsequently.

ALL SOLID STATE HF TRANSCEIVER
FT-301



The model FT-301 is a precision built, all solid state, compact high performance transceiver of advanced design providing SSB (USB, LSB selectable), CW, AM and FSK modes of operation covering 160m - 10m bands.

All circuits are fully transistorized with IC's and FET's for increased reliability. Instant operation, immediately after power is turned "on", provides tremendous convenience for mobile operation with minimum power consumption.

The power amplifier employs power transistors with extremely good linearity and large heat dissipation capability. A wide band tuning system, with preset pass band tuning combined with wide band amplifier techniques, eliminates the necessity of final amp tuning for each band change. In addition, the double protection circuit ensures protection of the components from damage due to antenna mismatch or failures.

The well established YAESU RF mu-tuning system is geared with a precision built vernier mechanism which provides bandspread tuning over a 16 kHz segment of the band per turn. The extremely stable VFO, combined with this vernier mechanism, permits precise tuning of the SSB signal. Rejection tuning utilizes an extremely sharp resonance characteristic of a crystal tunable over the entire IF pass band to reject interference.

The active filter in the audio circuit limits audio spectrum sharply within 3 kHz, which improves readability of the signal being received by eliminating interferences.

The noise blanker, with the latest noise detecting circuit, eliminates pulse type noise which has an extremely small amplitude for noise free reception.

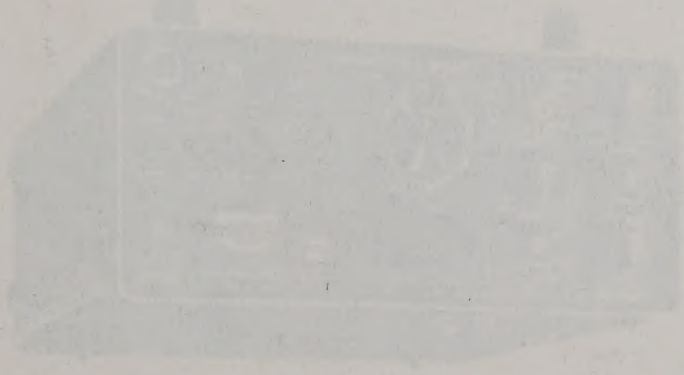
All features, such as VOX, semi-break-in CW with side tone, 25/100 kHz calibrator, noise blanker, speaker, fast/slow AGC, and clarifier are integral parts of the unit.

The built-in RF speech processor will be operative with installation of an optional crystal filter. It will provide increased talk power improving the intelligibility at the receiving end.

For mobile operation, fixed crystal controlled channels may be preferred. The FT-301 accepts 11 fixed channel crystals easily selectable from the front panel. The FT-301 offers wide versatility when used in conjunction with an external VFO, the FV-301.

Plug-in modules are employed for the main circuit systems permitting an orderly arrangement of the circuit signal flow with excellent isolation. This allows simplified service and alignment, while assuring unsurpassed stability. When operated on DC (13.5V), the transceiver requires no external power supply, as is required for hybrid type HF transceivers. This compact, light weight, yet feature packed transceiver is well suited for base or mobile operation. The AC power supply, FP-301 or FP-301D, is available for base station set-up.

Please read the operating manual carefully before attempting to operate the transceiver as it contains useful information which will assist you in achieving the maximum satisfaction from your YAESU FT-301.



SPECIFICATIONS

Frequency Range	:	160 m through 10 m (WWV/JJY, CB - - Receive only)
Emission	:	LSB, USB, CW, AM, FSK
Power Input	:	SSB 200 watts PEP CW 200 watts AM, FSK 50 watts (Slightly lower on 10 and 160 meter bands)
Carrier Suppression	:	Better than 40 dB
Sideband Suppression	:	Better than 50 dB
Transmitter Frequency Response	:	300 Hz ~ 2700 Hz -6 dB
Spurious Radiation	:	Less than -40 dB
Distortion Products	:	Better than -31 dB
Frequency Stability	:	Less than 100 Hz drift in any 30 minutes
Antenna Output Impedance	:	50 ohms unbalanced
Sensitivity	:	0.25 μV at S/N 10 dB
Image Ratio	:	1.9 ~ 21.0 MHz Better than 60 dB 28 MHz Better than 50 dB
IF Interference	:	Better than -70 dB
Selectivity	:	SSB 2.4 kHz at -6 dB 4.0 kHz at -60 dB CW, FSK 0.6 kHz at -6 dB 1.2 kHz at -60 dB AM 6 kHz at -6 dB 12 kHz at -60 dB
Audio Output	:	3 watts at 10 % THD
Output Impedance	:	4 ohms
Power Requirement	:	DC 13.5 V negative ground
Power Consumption	:	TX(max) 280 watts (21 A) RX 12 watts (1.1 A)
Size	:	280(W) x 125(H) x 370(D) mm
Weight	:	9 kgs approx.

SEMICONDUCTOR COMPLEMENT

Transistors:

2SA564A	1	2SC784R	5
2SA695D	1	2SC1000GR	2
2SB529D	1	2SC1383	1
2SC372Y	10	2SC1589	1
2SC373	8	2SD359D	1
2SC536D	2	MPSA13	1
2SC711F	1	S10-12	2
2SC735Y	6	S2535	2
2SC741	1	BY1-1	1

Field Effect Transistors:

2SK19GR	13	3SK40M	7
3SK35Y	1		

Integrated Circuits:

34013PC	1	SN7490AN	1
LD3141	1	SN74160N	1
MC1496G	2	SN74560P	1
MSL980Y2	1	SN76514N	1
MSM5564	1	TA7060P	1
SN7400N	3	TA7089M	1
SN7404N	2		

TA7120P	1	TP4011	1
TIL306	3	μPC14305	1
TIL308	3	μPC14308	1

Diodes:

1N60	24	BZ090	1
1S1007	12	WZ050	1
1S1555	40	WZ090	7
10D10	2	WZ110	1
1S2209	1	YZ033	1
1S2236	1		

Thyristor:

CW01B	1

Varistor:

MV5W	1

FT-301 is supplied complete with cable, connectors, fuse and microphone as shown below.

Figure 1

MODEL CHART FOR YAESU FT-301 SERIES

Model	Power Input	Frequency Readout
FT-301S	20W	Dial
FT-301SD	20W	Digital
FT-301	200W	Dial
FT-301D	200W	Digital

CONTROLS AND SWITCHES

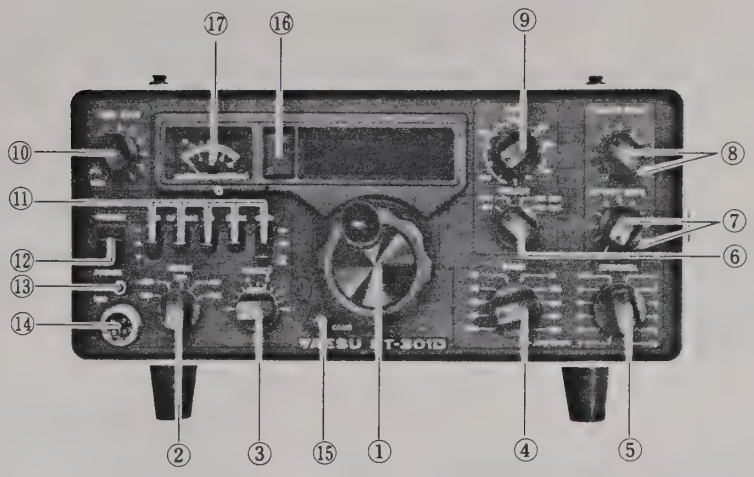


Figure 2 **Front Panel Controls & Switches**

(1) TUNING KNOB

The tuning knob varies receive and transmit frequencies over a continuous 500 kHz segment of a band. It is connected to the VFO through a precision built VFO drive mechanism. This vernier provides 16 kHz per turn allowing precise tuning for SSB signal.

(2) MODE

This switch selects the mode of operation: LSB (lower sideband SSB), USB (upper sideband SSB), CW (code operation), AM (amplitude modulation) and FSK (frequency shift keying).

(3) REJECT

This control varies resonance frequency of a crystal to reject interference. The control should normally be in the 9 o'clock position to avoid distortion of the received signal which may be caused by a sharp bandwidth.

(4) BAND

The eleven-position switch selects the desired band from 160m – 10m bands, plus JJY/WWV. The wave length of each selectable band is shown on the panel.

(5) CHANNEL

The channel switch selects any one of the 11 crystal positions used for fixed crystal controlled operation. This switch also selects the VFO for continuous tuning with the main tuning knob.

(6) SELECT

The select switch provides selection of the controlling VFO, either internal or external, or a combination for various splits.

- INT ..... The internal VFO controls both receive and transmit frequencies.
- EXT ..... The external VFO controls both receive and transmit frequencies.
- RX-EXT .... The external VFO controls the receive frequency and the internal VFO controls the transmit frequency.
- TX-EXT .... The external VFO controls the transmit frequency and the internal VFO controls the receive frequency.

Whenever the internal VFO is active, the sub dial lights up in red, indicating that the internal VFO is in operation.

(7) RF/AF GAIN

The RF gain lever allows manual control of the gain of the receiver RF and IF amplifiers. Clockwise rotation increases the sensitivity of the receiver. The AF gain knob control varies audio output level to the speaker and phone jack.

(8) DRIVER/CLAR

The drive lever controls the drive level in transmit. Clockwise rotation increases the transmit power output. The clarifier control varies receive frequency only up to 3 kHz on either side of the dial frequency affecting the transmit frequency. It is particularly useful in "net" operation where several participants may be transmitting slightly off frequency. The clarifier control functions in conjunction

with the CLAR switch. When the CLAR switch is turned on, the CLAR indicator will light up, and the CLARIFIER is energized. The CLAR switch should normally be in the "off" position until the initial contact is made. The CLARIFIER control may then be used to zero-in and correct any drift on the received signal. The CLARIFIER control must also be set to "off" while calibrating the dial.

(9) **TUNE**

The tune switch peaks the receiver and transmitter circuits by means of a mu-tuning system coupled to a vernier mechanism. It provides continuous permiability tuning throughout the frequency range of the transceiver.

(10) **VOX GAIN**

Selects MOX, PTT and VOX (voice controlled operation) as well as adjusting the sensitivity of VOX operation. The PTT position provides push-to-talk operation. The MOX position provides manual transmit. It must be returned to PTT position for receiver recovery.

(11) **FUNCTION SWITCHES – (AGC, RF PROC, NB MARK, CLAR)**

AGC . . . . . This switch selects AGC time constant – fast, slow and "off".

RF PROC . . RF speech processor is placed into the circuit to increase the modulation power with the switch "on" position.

NOTE: An optional crystal filter is required for this operation.

NB (Noise Blanker) . . . . . Inserts the noise blanker into the IF circuit to eliminate pulse type noise.

CLAR . . . . With the clarifier switch in RX position, the CLARIFIER control varies the receive frequency slightly. With the CLARIFIER switch in TXRX position, both transmit and receive frequencies are varied slightly by the CLARIFIER control.

MARK . . . The marker oscillator generates signals every 100/25 kHz for calibration of the dial with MARK switch "on".

(12) **POWER**

The power switch turns the transceiver "on" and "off".

(13) **PHONES**

The phones jack accepts the headphone plug. The internal or external speaker in the FP-301 (if used) is disabled whenever a headphone is plugged in. Use low impedance (4 ohm) headphones.

(14) **MIC**

The microphone jack has a four-pin connector and is used for microphone input as well as PTT control.

(15) **CALIB**

The CALIB knob shifts display frequency for calibration of the frequency display.

(16) **CLAR/FIX/VFO**

CLAR lights up when the CLAR switch is turned on, indicating the clarifier is in use. VFO lights up indicating tuning dial is in operation. FIX lights up indicating fixed crystal controlled channel is in operation and the VFO is disabled.

(17) **METER**

Functions as an "S" meter on receive and reads collector current of the PA on transmit.

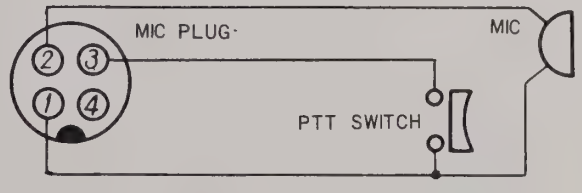


Figure 3 **Microphone Plug Connection**

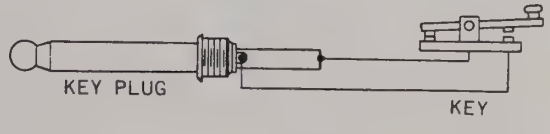


Figure 4 **Key Plug Connection**

REAR PANEL CONNECTIONS

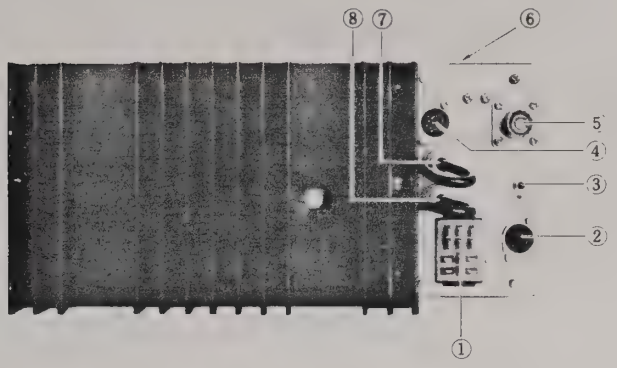


Figure 5

(1) **POWER**

- DC power supply receptacle. For AC operation use FP-301 power supply with built-in speaker. When the transceiver is used together with the FP-301, the speaker in the transceiver is disabled.

(2) **EXT VFO**

- interface for external VFO unit. Supplies power to the FV-301, external VFO unit (if used).

(3) **KEY**

- key jack for code operation. Keying is through closure of a +5V DC line. If electronic keyers are used, polarity should be checked.

(4) **ACC**

- accessory socket. Provides +13.5V for control of an external relay.

(5) **ANTENNA**

- coaxial connection for antenna.

(6) **PO ADJ**

- meter sensitivity adjustment for relative power output reading.

(7) **OUT**

- RF output is obtained from the driver stage for final linear amplifier at this jack. This output may also be used for optional equipment such as a 6 or 2 meter transverter.

(8) **IN**

- input jack for a low pass filter. Booster amplifier is connected here.

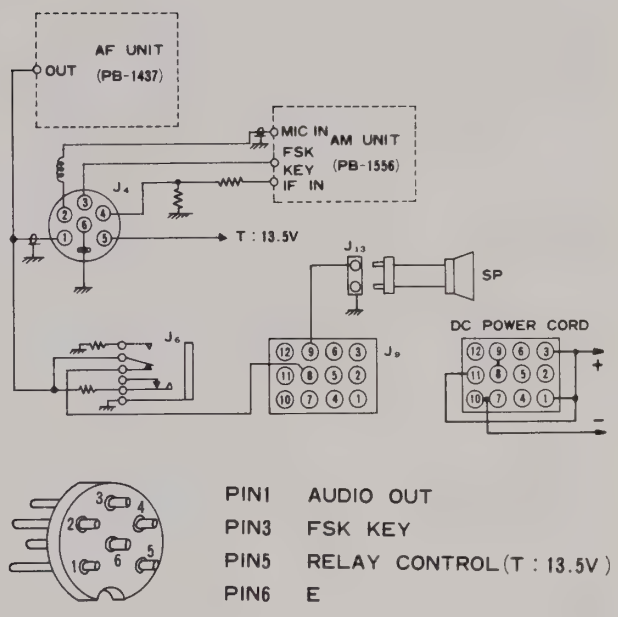


Figure 6 **ACC Plug Connection**

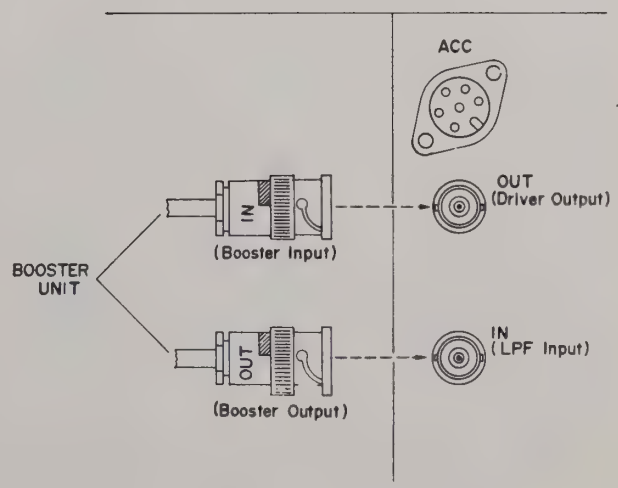


Figure 7

RECEIVE-TRANSMIT SWITCHING

There are several ways to activate the unit for receive-transmit switching.

MOX (MANUAL) OPERATION

Setting the VOX GAIN control to MOX or PTT position will transmit or receive respectively. This is convenient for continuous transmit on RTTY, or for transmitter adjustment.

PTT (PUSH-TO-TALK) OPERATION

The PTT switch accompanied by microphone is used for keying. Pressing the PTT switch will transmit and releasing will receive. The VOX GAIN control must be set to the PTT position.

VOX (VOICE CONTROLLED) OPERATION OR CW BREAK-IN

VOX or CW break-in operation is available to the operators as follows:

(1) For SSB VOX operation, adjust the VOX GAIN control on the front panel until your voice actuates the transmitter while speaking normally into the microphone.

(2) Set the ANTI TRIP control located inside the cabinet to the minimum point in order to prevent the speaker output from tripping the VOX circuit. Do not use more VOX GAIN or ANTI TRIP gain than necessary.

(3) Adjust the DELAY control for a suitable release time.

(4) For CW operation, break-in is available by use of the VOX circuit. As you stop keying, the unit will automatically return to receive, and you can hear the other station between your dots and dashes. Adjust the DELAY control for suitable release/delay time.

DIAL CALIBRATION

The dial of the transceiver is designed to indicate the carrier frequencies, therefore, there will be 3 kHz difference between USB and LSB. When calibrating the dial, the CLAR switch must always be set to the "off" position.

SSB MODE

(1) Select the desired mode (USB, LSB), band and frequency.

(2) Turn the MARK switch on the front panel to "on", which will activate the marker oscillator. The marker frequency is selectable for either 25 kHz or 100 kHz by the switch S601 located on the VOX unit.

(3) As you turn the dial knob, a beat will be heard every 25 kHz or 100 kHz depending on the position of S601. Set the dial to the 25 kHz or 100 kHz point nearest to the desired frequency.

(4) Tune the dial knob for a zero beat (lowest pitch frequency). Adjust CALIB control for correct frequency indication in the dial window.

CW OPERATION

The procedure is similar to that of SSB operation except the calibration points will differ by bands.

(1) All bands except 80 meter band -

Set the MODE to CW

Tune the dial knob for a zero beat. Adjust CALIB control until the display frequency becomes 800 Hz lower.

(2) The 80 meter band -

Tune the dial knob for zero beat. Adjust CALIB control until the displayed frequency shows 800 Hz higher.

(3) If an optional CW filter is installed, the calibration should be taken by reading the maximum S meter deflection instead of zero beat.

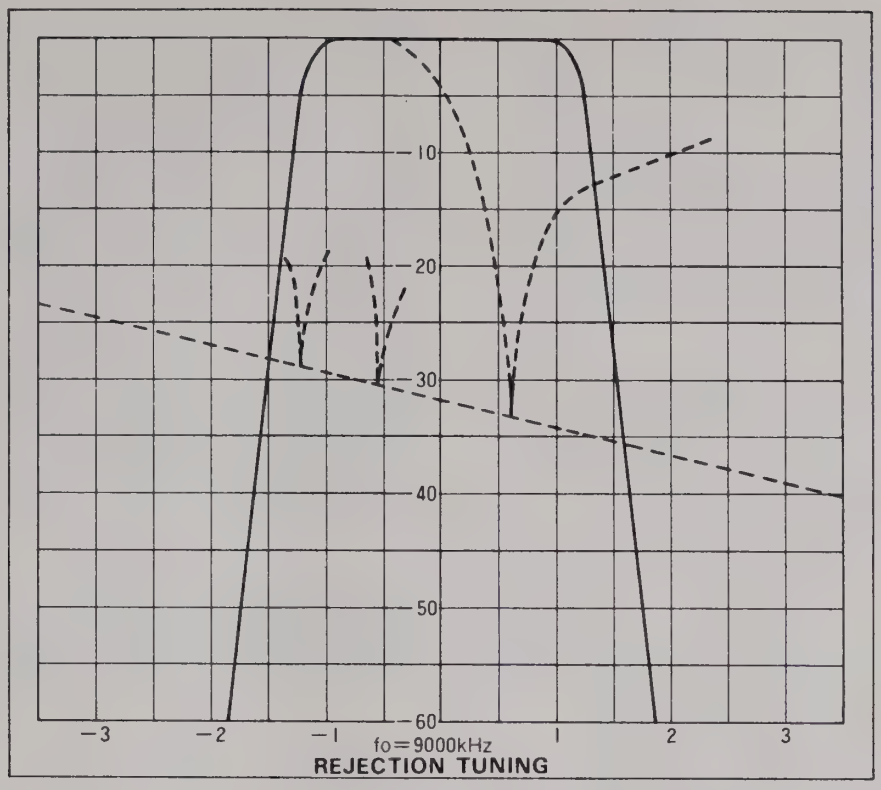


Figure 8 **Tunable Rejection Tuning**

PRESETTING FOR TRANSMIT

It is necessary to preset the transceiver regardless of mode of operation.

(1) Set the controls and switches to the positions indicated.

MODE	CW
RF PROC	OFF
DIAL	DESIRED FREQUENCY
TUNE	DESIRED BAND SEGMENT
SELECT	INT
BAND	DESIRED BAND
DRIVE	FULLY CCW
CHANNEL	VFO

(2) Turn the power switch "on". (If the AC power supply FP-301 is used, turn on the power switch of that unit too).

(3) By setting the VOX GAIN to the MOX position, the FT-301 will transmit until the switch is returned to the PTT position.

(4) Rotate the DRIVE control until the meter indicates 10 amps, then adjust the TUNE control for maximum meter deflection. The meter indicates 15 amps at full input.

(5) If a dummy load or an antenna with SWR less than 1.5 is used, you may increase the DRIVE control until the maximum power output is attained.

(6) If the SWR of the load or antenna system is higher than 1.5, the power output automatically decreases to protect the final amplifier transistor.

(7) With an appropriate load (or antenna) the meter will normally read 15 when the DRIVE is fully clockwise.

(8) Return the VOX GAIN control to the PTT position.

NOTE: With the key plugged into the rear key jack, transmitter does not load up unless key is down.

After completion of presetting the transceiver, follow this procedure to transmit in SSB.

(1) Connect the mike plug to the MIC jack.

(2) Place the MODE switch to the USB or LSB position, as desired.

(3) Turn the DRIVE control fully clockwise.

(4) Speak into the microphone while pressing the PTT switch on the mike. The meter should indicate 1/3 – 1/2 as compared to the CW position.

(5) If the meter reading does not fall into the specified range, adjust the MIC GAIN control (located inside the cabinet) for proper reading of the meter.

(6) By releasing the PTT switch, the unit will return to receive mode.

(7) By turning the RF PROC switch on, the RF speech processor is inserted into the circuit. (The optional crystal filter must be installed). The RF speech processor will increase talk power which is particularly effective in DX contacts. For local contacts, operation without RF speech processor is recommended.

The RF Processor increases talk power to cut through the pile-ups without addition of a linear amplifier.

After completion of presetting the transceiver, follow the procedure to transmit in CW.

Keying is accomplished by closing the DC 5V line to ground. The current that flows in the KEY is around 6mA. Use caution when an Electronic Keyer is used, to be sure polarity reversals or excessive voltages do not cause damage to one or both units.

(1) Insert a properly wired key plug into the KEY jack on the rear panel.

See illustration on Page 5.

(2) Set the MODE switch to CW position.

(3) Closing the circuit will transmit CW when the VOX GAIN control is placed on the MOX position. The meter reading should be zero when the key is open, and 15 when the key is closed. The receiver will be disabled until the MOX switch is returned to PTT.

(4) You may monitor the keying. (The monitor circuit is built in the VOX unit).

(5) Repositioning the VOX GAIN control to the PTT position will return the unit to receive.

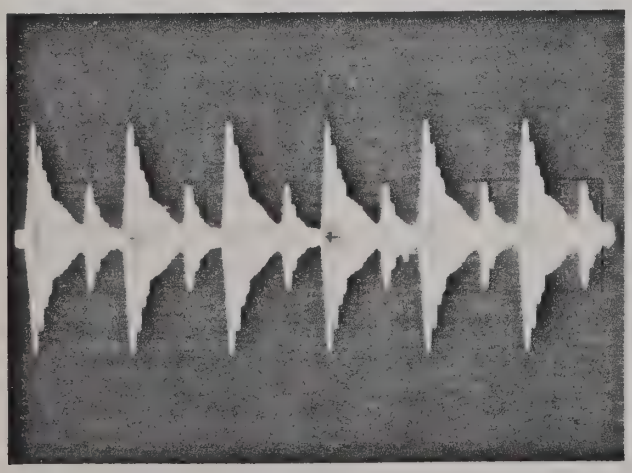


Figure 9 RF Processor "OFF"

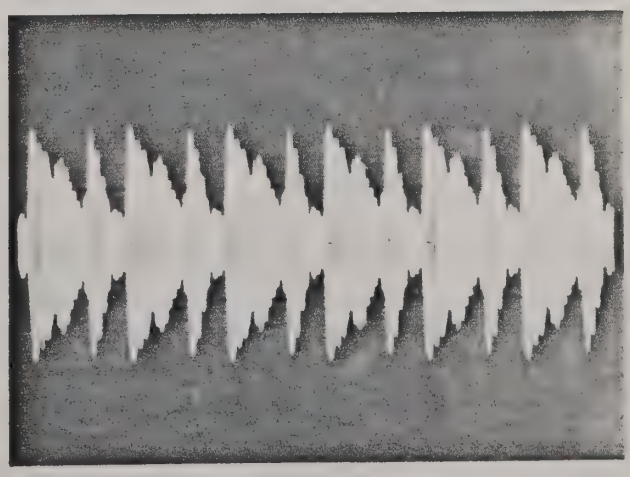


Figure 10 RF Processor "ON"

SELECT SWITCH

The SELECT switch provides selection of a companion FV-301 external VFO, which is very useful in DX work because it provides the operator with split frequency capability.

INT ..... The internal VFO controls both receive and transmit frequencies of the FT-301.

EXT ..... The external VFO controls both receive and transmit frequencies of the FT-301.

RX ..... The external VFO controls the receive frequency of the FT-301 and the internal VFO controls the receive frequency.

TX ..... The external VFO controls the transmit frequency of the FT-301 and the internal VFO controls the receive frequency.

The FIX indicator will light up when a crystal controlled channel is used.

CRYSTAL CONTROLLED OPERATION AND CRYSTAL FREQUENCIES

Fixed frequency crystals must be placed in the crystal holders on the FIX UNIT located inside the cabinet in order to operate on a fixed frequency within a band. The crystal sockets correspond to CH-1, CH-2 ..... CH-11, counting from the one nearest the front panel. The last one, 12th socket, is an auxiliary. When the CHANNEL switch is in the VFO position, the internal VFO is controlling the transceivers, and when the switch is on any other position between 1-11, the corresponding fixed crystal frequency controls the transceiver.

CALCULATION OF CRYSTAL FREQUENCIES

The crystal holders accept standard HC-25/U type crystals. All crystal frequencies must fall between 5,000–5,500 kHz.

The correct crystal frequency for any desired operating frequency may be determined by using the following formula:

$$F_X = F_1 - F_0$$

where F_X: **crystal frequency**
F_0: **operating frequency**
F_1: **constant taken from Table 1**

MODE / BAND	U S B	L S B	CW · AM FSK
160m	6998.5	7001.5	7000.7
80m	8998.5	9001.5	8999.3
40m	12498.5	12501.5	12500.7
20m	19498.5	19501.5	19500.7
15m	26498.5	26501.5	26500.7
10mA	33498.5	33501.5	33500.7
10mB	33998.5	34001.5	34000.7
10mC	34498.5	34501.5	34500.7
10mD	34998.5	35001.5	35000.7

Table 1 F_1 (kHz)

Example (1) – To find the proper crystal for 7099 kHz LSB operation -

From Table 1, F_1 for the 40 meter band LSB is 12501.5
Therefore, F_X = 12501.5 – 7099 = 5402.5 kHz

Example (2) – Find the crystal frequency for 21420 kHz USB operation -

From the table, F_1 = 26498.5
Therefore, F_X = 26498.5 – 21420 = 5078.5

CAUTION

The crystal that is intended to operate on a specific frequency will still be active when the band is switched to other bands. For example, with the same crystal (5078.5 kHz) as in example 2, the unit will operate on 7423 kHz LSB or 7420 kHz USB, well above the 40 meter band amateur allocation. Note that these frequencies are completely out of the normal band and should never be operated, unless you are authorized to do so.

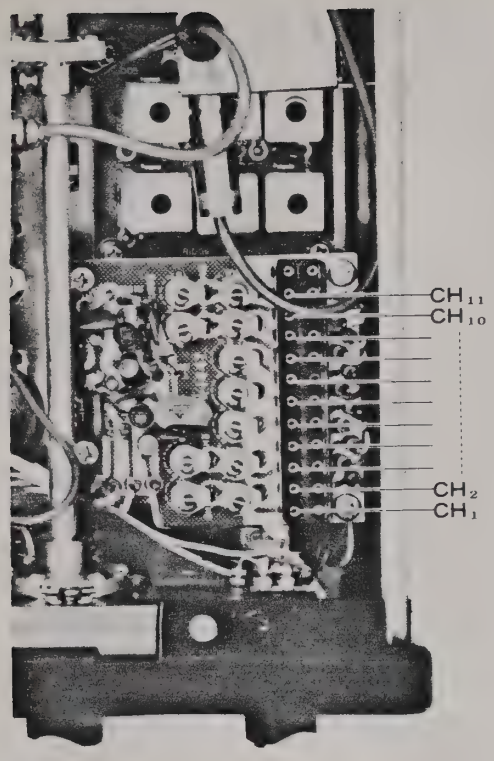
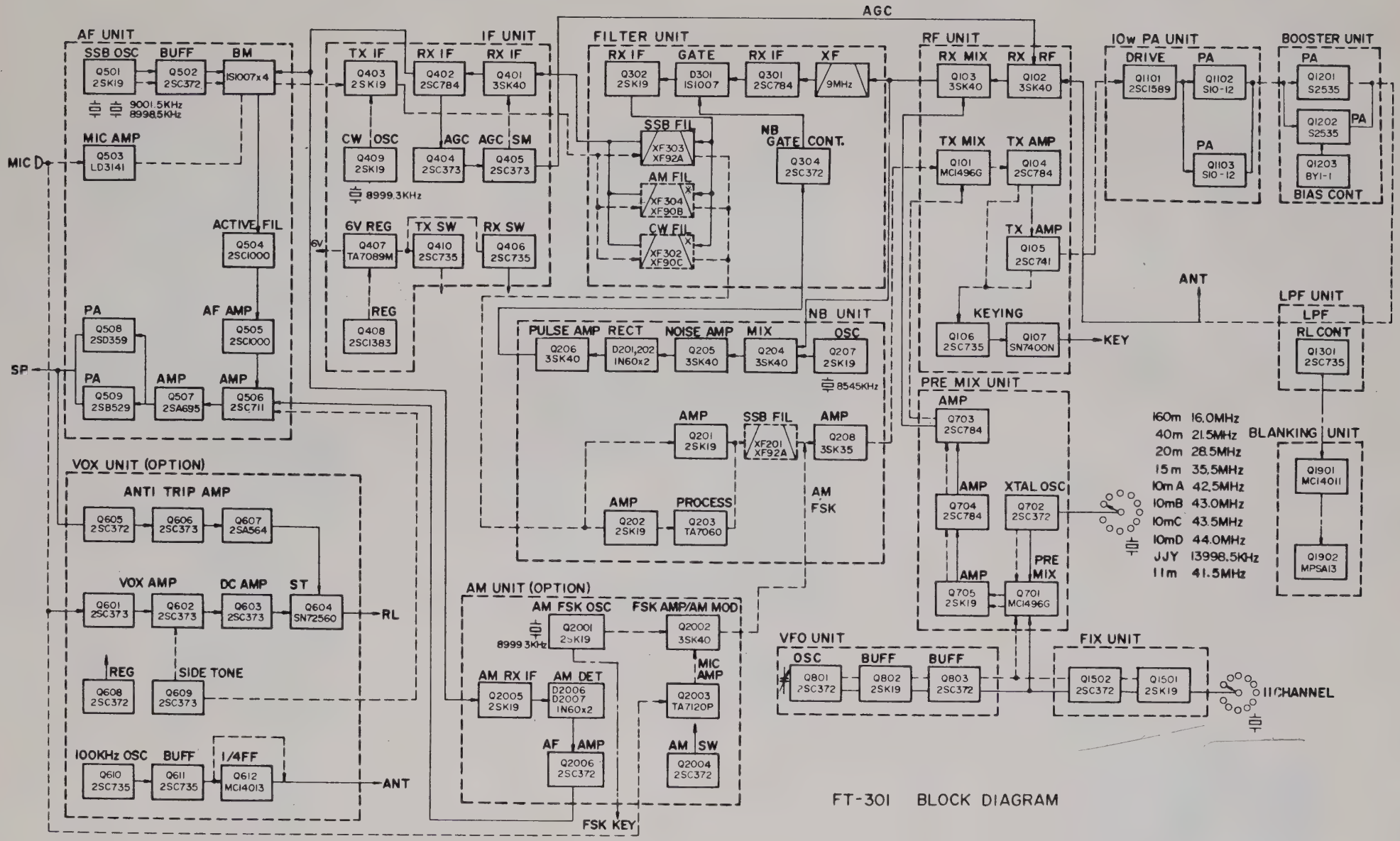


Figure 11

If ordering non YAESU fixed crystals from a crystal manufacturer, be sure to specify the crystal correlation information shown below, in addition to the frequency of the crystal.

TYPE HC-25/U
LOAD CAPACITANCE ... 30 PF
SERIES RESISTANCE ... 25 ohms or less
STATIC CAPACITANCE . 7 PF or less
DRIVE LEVEL ..... 5 mW

BEFORE BEGINNING ANY PROCEDURE DESCRIBED, READ THE INSTRUCTIONS THROUGH COMPLETELY AND KNOW AND UNDERSTAND IN ADVANCE WHAT IS BEING ACCOMPLISHED.



FT-301 BLOCK DIAGRAM

Figure 12 **Block Diagram**

CIRCUIT DESCRIPTION

The block diagram and the circuit description that follows, will provide you with a detailed understanding of this transceiver design. Computer type plug-in modular construction is used throughout the transceiver for RF isolation, service and alignment purposes.

The transceiver consists of a premix type single conversion system with a 9 MHz IF for all modes of operation.

RECEIVER

The RF input signal from the antenna is fed to pin 4 of the RF unit (PB-1443) through RL-1 (relay), trap T1401/C1413 in the trimmer unit and T1, the permiability tuned RF input coil.

RF UNIT (PB-1433)

The incoming signal is amplified by the RF amplifier Q_{102}, **3SK40M** FET, and then fed to the gate of the mixer Q_{103}, **3SK40M**, where the input RF signal is heterodyned with a local signal delivered from pre-mix circuit (PB-1439), producing an IF signal of 9 MHz at pin 11, through T102.

The input and output of the RF amplifier are permiability tuned circuits which provide high sensitivity with excellent rejection of unwanted out-of-band signals.

FILTER UNIT (PB-1435)

The IF signal received at pin 2 is passed through the monolithic filter **XF-301** which has a ±10 kHz

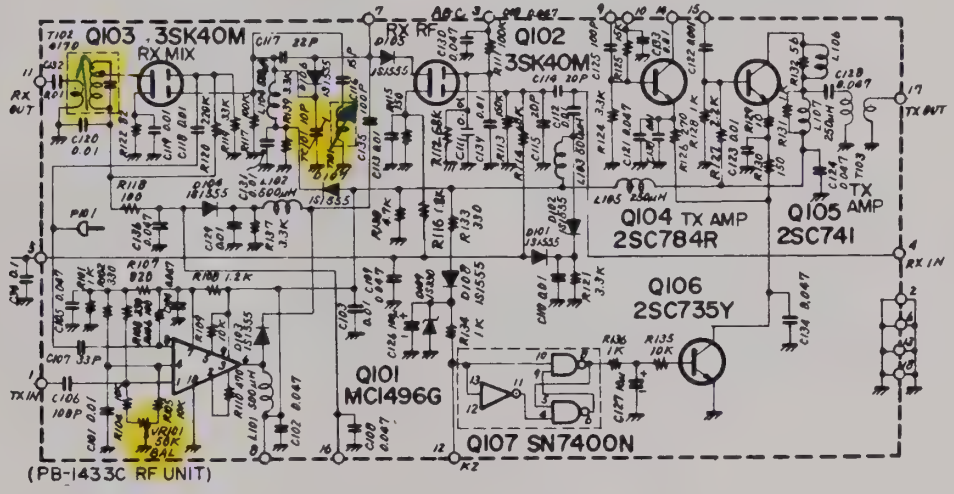


Figure 13 RF Unit (PB-1433)

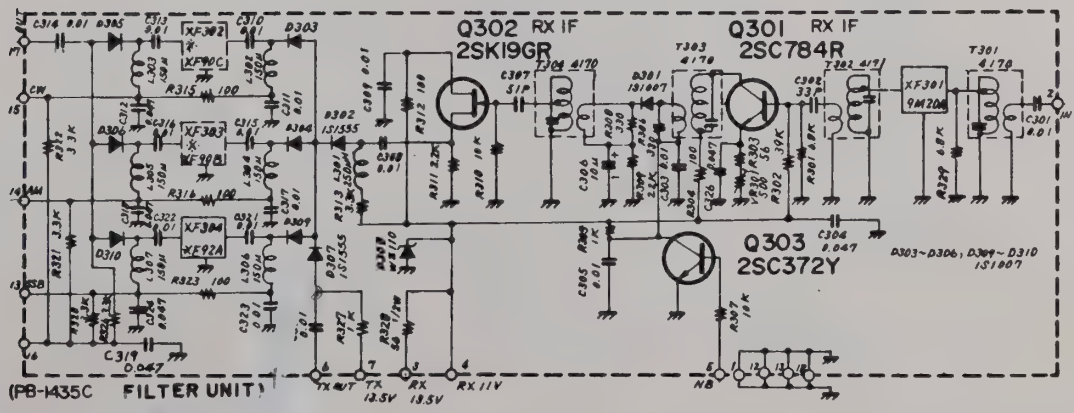


Figure 14 Filter Unit (PB-1435B)

bandwidth, providing additional selectivity. enough delay time is designed into the filter circuit to match the timing with the noise blanker output.

The noise blanker diode D_{301}, **1S1007**, is placed between the two IF amplifiers Q_{301}, **2SC784R**, and Q_{302}, **2SK19GR**. The noise blanker diode D_{301} functions as ON/OFF switch which is controlled by the noise blanker driver Q_{303}, **2SC372Y**.

The output from the source of Q_{302} is passed through the SSB or CW (option) filter which has been selected by diode switches D_{303} –D_{306}, **1S1007**, depending on the mode of operation. The filtered out clean IF signal is transferred to the IF unit (PB-1436) through pin 17.

IF UNIT (PB-1436)

The IF signal from pin 17 of the FILTER UNIT appears at pin 14 of the IF UNIT (PB-1436). The signal is further amplified by Q_{401}, **3SK40M**, and Q_{402}, **2SC784R**. The output from Q_{402} is coupled to a rejection tuning circuit to eliminate the interference, then supplied to the AF unit from pin 5.

A portion of the IF signal is picked up by C_{408}, 10 PF, and is rectified by D_{407}, **1S1555** to produce AGC voltage. It is further amplified by the DC amplifier Q_{404} and Q_{405}. The DC output voltage is then fed to the gates of Q_{102}, RF amp, and Q_{401}, IF amp to control the gain of these stages for AGC purposes.

The AGC voltage produced at the emitter of Q_{405}, **2SC373** is used for S-meter indication.

The RF GAIN control on the front panel varies the AGC voltage, applied to the base of Q_{404}, **2SC373** providing manual control of the gain of the RF and IF stages.

Also, assembled onto the IF UNIT board is a 6V regulated power supply for the CARRIER, VFO, FIX, and LOCAL circuits.
DC 13.5V is applied to the collector of Q_{408}, **2SC1383**. The base voltage of Q_{408}, **2SC1383** being fixed by the zener diode D_{409}, **WZ 090**, DC 8.5V is generated from the emitter, which is further stabilized by Q_{407}, regulator IC **TA7089M** to produce 6V DC.

Q_{406} and Q_{410}, **2SC735Y** are transistor switches. On receive, Q_{406} conducts to supply 6V to an external receive VFO through pin 8. On transmit, Q_{410} conducts to supply 6V to an external transmit VFO through pin 16.

AM UNIT (CPB-1556)

The signal from IF unit is also fed to AM unit from pin 12 for AM detection. The signal is amplified by Q_{2005}, **2SK19GR** and applied to a diode detector consisting of D_{2006} and D_{2007}, IN60. Detected audio signal is amplified by Q_{2006}, **2SC372Y** and fed through AUDIO GAIN control to the AF unit.

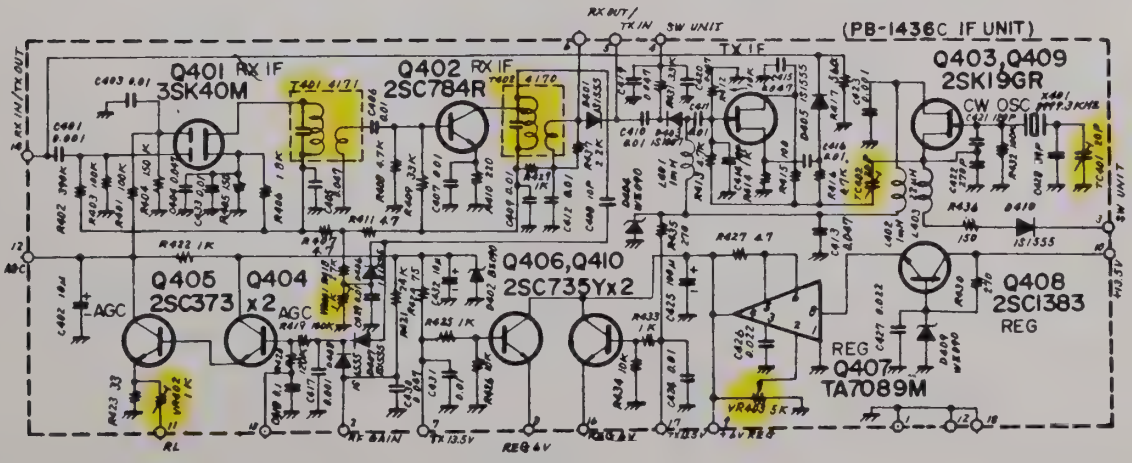


Figure 15 **IF Unit (PB-1436B)**

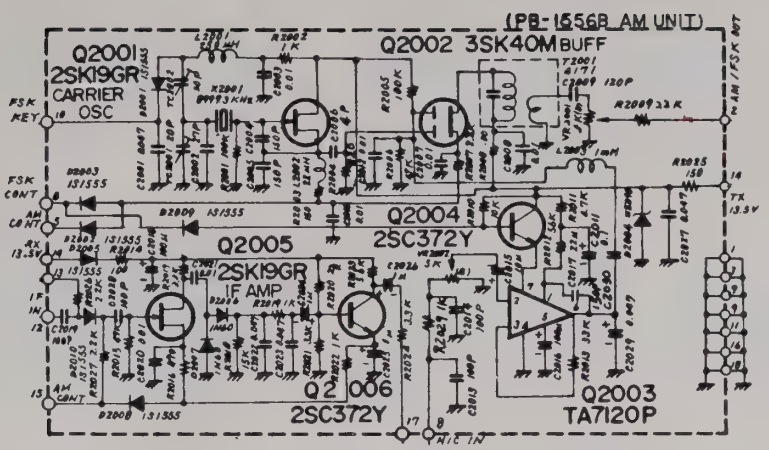


Figure 16 AM Unit (PB-1556)

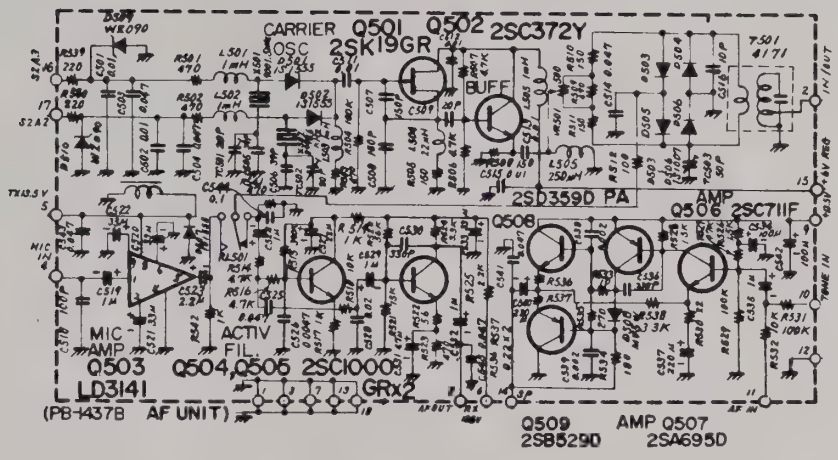


Figure 17 AF Unit (PB-1437)

AF UNIT (PB-1437)

The 9 MHz IF signal is delivered to pin 2 from PB-1436. A balanced demodulator circuit consisting of D_{503} – D_{506}, **1S-1007** demodulates the 9 MHz IF signal into audio using the appropriate USB or LSB frequency being applied from Q_{501}, **2SK19GR**, carrier oscillator and Q_{502}, **2SC372Y**, buffer amp. The demodulated audio then goes through relay contacts to an active low pass filter, Q_{504}, **2SC1000GR**. The audio spectrum is shaped by the decay curve so that it has an attenuation slope of −3dB at 2.3 kHz and −6dB at 2.6 kHz.

The filtered audio is amplified by Q_{505}, **2SC1000GR**, and the signal travels from pin 8 to pin 11 through the AF GAIN control, providing manual audio level control. The audio signal returned to pin 11 is amplfied by Q_{506}, **2SC711A**, Q_{507}, **2SA695D**, and finally by OTL power amplifier Q_{508}, **2SD359D** and Q_{509}, **2SB529D** producing a maximum of 3 watts audio output into the speaker.

The carrier oscillator Q_{501}, **2SK19GR** is followed by a buffer amplifier Q_{502}, **2SC372Y**. It oscillates either 8998.5 kHz with **X502** or 9001.5 kHz with **X501** depending on the mode of operation. The crystal selection is made by diode switches D_{501} and D_{502}, **1S1555**. The carrier is then injected into the balanced demodulator through VR_{501}.

The diode D_{502} conducts to activate the crystal for 8998.5 kHz, used for LSB on 160, 40, 20, 15, 10 and USB on 80 meter band on both transmit and receive – 8998.5 kHz is also used for CW receive on all bands.

The diode D_{501} conducts to activate the crystal for 9001.5 kHz for USB on 160, 40, 20, 15, 10 and

LSB 80 meter bands.

For CW transmit, the oscillator in the IF UNIT (PB-1436) oscillates at 8999.3 kHz carrier frequency.

NB UNIT (PB-1434)

A portion of unfiltered 9 MHz IF is fed to pin 5, and appears at Q_{204}, **3SK40M**, where the 8545 kHz signal generated by **X201** and Q_{207}, **2SK19GR** is mixed with the incoming IF signal to produce 455 kHz. The 455 kHz is then amplified by Q_{205}, **3SK40M**.

When a carrier, or noise free modulated signal is received, the 455 kHz signal with its corresponding strength, is rectified by D_{201} and D_{202} to charge C_{221}. There is no discharge loop for C_{221}, therefore, signals which exceed the charged voltage established by the reference voltage on C_{221} will not pass through D_{201} and D_{202}, **1N60**. Accordingly, there will be no voltage drop across R_{226}, and Q_{206}, **3SK40M**, will conduct as the gate voltage approaches zero potential. When Q_{206} conducts, the drain voltage at pin 2 of printed board will drop.

The drain of Q_{206} is directly connected to the base of Q_{303}, **2SC372Y** in the FILTER UNIT. As the drain voltage of Q_{206} drops, the base voltage of Q_{303} drops, as well, which will turn off Q_{304}. The collector voltage will then increase and it will produce a forward bias to D_{301}. As D_{301} conducts, the signals will pass normally through the circuit.

When pulse type noise, which exceeds the charged reference voltage established by C_{221} is received, D_{201} and D_{202} will permit negative going pulses to turn Q_{206} off. The drain voltage will rapidly increase as it turns off.

As the drain voltage increases, Q_{303} will become "on" and the collector voltage will decrease. Accordingly, D_{301}, **1S 1007** will be biased to block the signal. Whenever pulse type noise is received, it will blank off the signal passage momentarily.

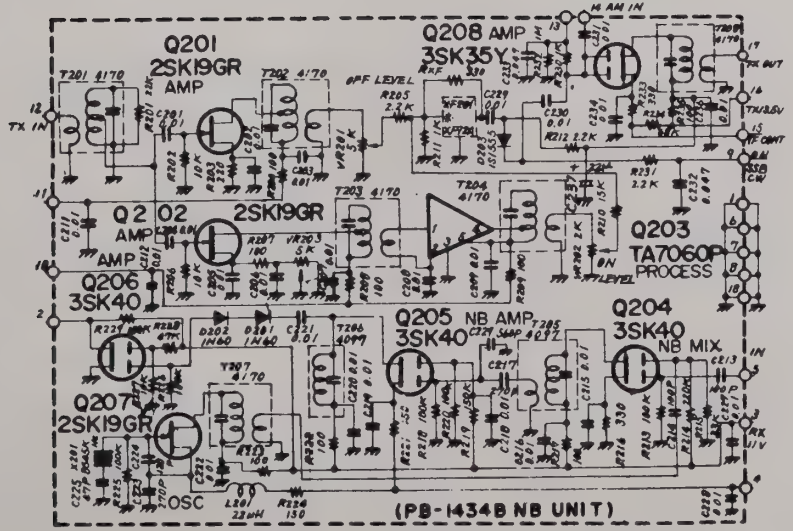


Figure 18 NB Unit (PB-1434)

TRANSMIT CIRCUIT

Audio signals pass through the MIC jack, J8 and go to pin 4 of the AF UNIT through VR_{1901}, MIC GAIN control.

AF UNIT (PB-1437)

From pin 4, the audio signal passes through Q_{503}, **LD3141**, is amplified, then is applied through RL501 into a balanced modulator D_{503} through D_{506}, **1S1007**, where the carrier generated by X_{501} or X_{502} is modulated by the audio. The output becomes a 9 MHz DSB signal and is fed to the IF UNIT.

AM UNIT (PB-1556)

For AM (amplitude modulation), the microphone signal is fed through a level set potentiometer VR2002 to a microphone amplifier Q_{2003}, **TA7120P** which is controlled by Q_{2004}, **2SC372Y**. Q_{2004} supplies the base voltage to Q_{2003} when the MODE switch is set to an AM position.

Carrier oscillator, Q_{2001}, **2SK19GR** generates a crystal controlled carrier frequency of 8999.3 kHz. The carrier and microphone signals are fed to an AM modulator Q_{2002}, **3SK40M**. The amplitude modulated signal is fed through pin 2 to pin 14 of NB unit and amplified by Q_{208}, **3SK35Y**.

The carrier frequency is shifted 170 Hz for FSK and the signal is then applied through Q_{2002} which works as a buffer amplifier to Q_{208} in the NB unit.

IF UNIT (PB-1436)

The 9 MHz DSB signal enters into pin 5 and is amplified by Q_{403}, **2SK19GR**. It then goes into the FILTER UNIT from pin 14. The function of Q_{409}, **2SK19GR** is to oscillate 8999.3 kHz carrier for for CW transmit. The carrier is amplified by Q_{403}, **2SK19GR** and then goes into pin 17 of the FILTER UNIT from pin 14 of the IF UNIT.

FILTER UNIT (PB-1435)

In the FILTER UNIT, the DSB signal is converted into SSB by the filter, **XF-303** by removing the unwanted sideband. From pin 6 the SSB signal is fed into pin 12 of the NB UNIT (PB-1434B). The signal is fed to the speech processor circuit which is built into this NB unit.

NB UNIT (PB-1434)

When the RF PROC switch is "OFF", the SSB signal entered at pin 12 is amplified by Q_{201}, **2SK19GR** and then is applied to the XF-201 filter which is optional.

When the RF PROC switch is "on", the SSB signal is amplified by Q_{202}, **2SK19GR** and is further amplified by the limiter IC, Q_{203}, **TA7060P** where the signals that exceed the clipping level are sliced out.

The clipping level may be adjusted by VR_{203}, VR_{201} and VR_{202} to adjust the signal level differences caused by the PROCESSOR "on" or "off". This highly clipped SSB signal is then followed by a selective filter **XF-201** to remove RF harmonics and out of band intermodulation products that result from signal clipping.

The filtered out clean signal is amplified by Q_{208}, **3SK35Y** and fed to pin 1 of the RF UNIT (PB-1433).

RF UNIT (PB-1433)

The signal from pin 1 is applied to the double balanced mixer Q_{101}, **MC1496G** where the SSB signal is heterodyned to the desired RF frequency by injection of the local signal which is supplied from the PRE-MIX UNIT (PB-1439) through P101.

The RF output from Q_{101} passes through T2, then into the two stage amplifier on board PB-1433, Q_{104}, **2SC784R** and Q_{105}, **2SC741** to drive the 10W power amplifier, PB-1443.

The transformers T2 and T3 are permiability tuned type which are used for both receive and transmit to provide unsurpassed selectivity in both modes.

In CW operation, the emitter voltage of Q_{104} and Q_{105} are controlled by the keying switch transistor Q_{106}, **2SC735Y**.

A flip-flop circuit consisting of Q_{107}, **SN7400N**, is employed to shape perfect waveforms for keyclick free CW operation at any speed.

Q_{106} and Q_{107} also function as the protection switch when the protection circuit on the LPF UNIT (PB-1445) is activated for any reason, such as excessive SWR, short, etc.

POWER AMP UNIT (PB-1443)

The exciter output from pin 17 of the RF UNIT (PB-1433) is amplified by the driver Q_{1101}, **2SC1589**, to drive the push-pull power amplifier, Q_{1102} and Q_{1103} **S10-12**, to produce a nominal power output of 10 watts.

A non-resonant, broad band type power amplifier, utilizing ferrites and the most advanced circuitry is used to eliminate the nuisance tuning process usually required for each band. These techniques also protect the power transistors from erroneous tuning procedures.

The zener diode D_{1101} **YZ033** sets the bias for Q_{1101} – Q_{1103} at exactly 3V. The silicon diodes D_{1102} and D_{1103}, **10D10** are mounted on the power transistors Q_{1102} and Q_{1103} to compensate bias, as well as to protect them from thermal runaway.

The negative feedback circuit delivers a clean signal to the following booster amplifier.

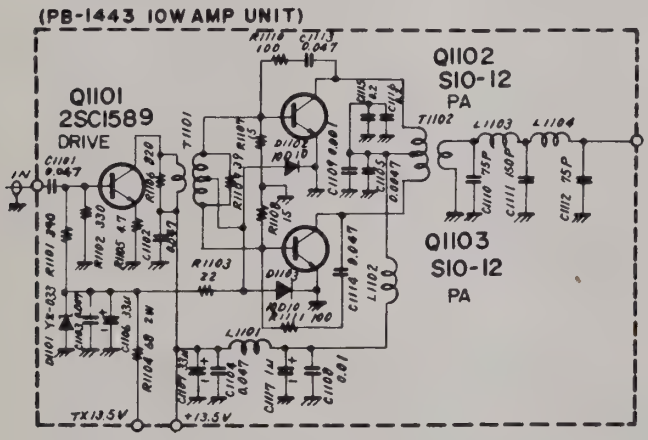


Figure 19 10W Amp Unit (PB-1443)

BOOSTER UNIT (PB-1444)

The booster unit is built in the heat sink which is attached to the rear panel of the transceiver. The 10 watts signal is fed through an input network to a pair of **S-2535**, Q_{1201} and Q_{1202} which are connected in push-pull amplifier configuration.

This circuit is a non-resonant broad band type amplifier covering 160 through 10 meter bands. A part of output energy is feedbacked in negative polarity to the input circuit.

This negative feedback circuit improves tremendously the linearity of the amplifier.

Q_{1203}, **BY1-1** is used to sterilize the bias voltage to the final amplifier. The amplified signal is fed into the two stage low pass filter consisting of L_{1205}, L_{1206}, C_{1214}, C_{1215} and C_{1216} to alternate the frequency beyond 35 MHz.

The RF output from the secondary winding of the output transformer is fed into the low pass filter, composed of L_{1103}, L_{1104}, C_{1110}, C_{1111} and C_{1112} to eliminate frequencies beyond 35 MHz.

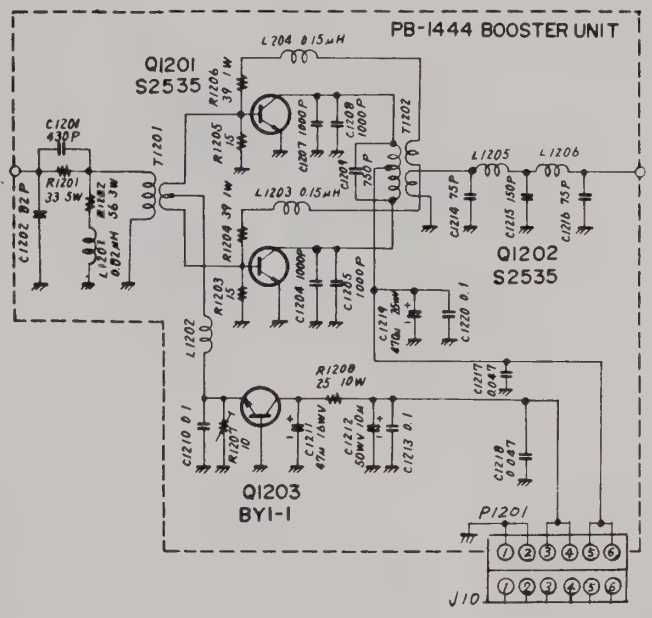


Figure 20 Booster Unit (PB-1444)

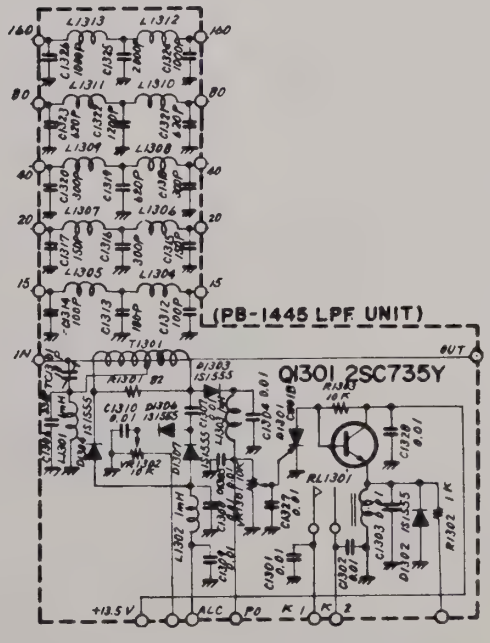


Figure 21 LPF Unit (PB-1445)

LPF UNIT (PB-1445)

The jacks, J2 and J3, are connected by a jumper wire for the 10 watts model. The band switches, S_2B_1 and S_2B_2, select the proper low pass filter network for the band in use.

The signal passes through T_{1301}, an output detector, and the antenna relay (RL1) to the antenna terminal, J1.

T_{1301} detects the forward and reflected waves. The forward wave is rectified by D_{1303}, **1S 1555**. When the forward power exceeds safety level, it will trigger the thyristor D_{1301}, **CW01B** which will, in turn, shut down Q_{1301}, **2SC735Y** and the protection relay RL_{1301} will be released.

When the relay opens, the voltage on the output side of Q_{107}, **SN7400N** on the RF UNIT (PB-1433) becomes low and Q_{106}, **2SC735Y** will turn off. As Q_{106} turns off, the emitter circuit for Q_{104}, **2SC784R** and Q_{105}, **2SC741** will become wide open and these transistors will turn off. As a result, no signal will be delivered to the power amplifier.

The forward wave is also rectified by D_{1306} and D_{1307}, **1S 1555** to obtain ALC voltage. The ALC voltage is fed back to the base of Q_{208}, **3SK35Y** in the NB UNIT to control the gain of that stage. At peak transmission, the ALC voltage will reduce the gain of Q_{208} to prevent overloading or distortion.

The output of the reflected wave from T_{1301} is rectified by D_{1304}, **1S 1555** to obtain ALC voltage. When there is an excessive amount of reflected power due to an antenna mismatch, the reflected wave is rectified by D_{1305}, **1S 1555** and the voltage is used for ALC to reduce the gain of Q_{208} which will also reduce the corresponding input level to the power transistors.

BLANKING UNIT (PB-1451)

While the protection circuit is activated, Q_{1301} will be off and there will be no voltage drop across the relay coil connected to the emitter. This lack of emitter voltage (0V) is used to activate the BLANKING UNIT.

Under normal operating conditions, the output of the bi-stable Q_{1901}, **TP4011** is in HIGH level which will turn Q_{1902}, **MPSA13** on allowing current to flow through the meter lamp for meter illumination.

When the protection circuit is activated, the input to the BLANKING UNIT becomes zero volts. The bi-stable will then oscillate to blink the meter lamp indicating existence of problem and alerting the operator to this fact.

Also on the board are the MIC GAIN control VR_{1901} and the clarifier zero adjustment pot, VR_{1902}.

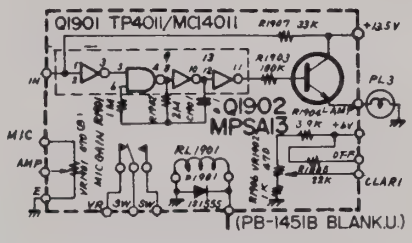


Figure 22 **Blanking Unit (PB-1451)**

VOX UNIT (PB-1438)

(1) VOX (Voice Controlled Operation)

A portion of the mike input is delivered to pin 10 of the VOX UNIT. The signal is amplified by Q_{601} and Q_{602}, **2SC373**, is then rectified by D_{601}, 1N60 to produce positive DC at the base of Q_{603}, **2SC373** causing it to conduct, thus reducing the voltage at pin 6 of Q_{604}, **SN72560P**. The output at pin 4 will be zero which will then actuate the VOX relay, RL1.

Q_{604} is a level detector having a hysteresis characteristic and a transistor switch built in.

(2) ANTITRIP CIRCUIT

The ANTITRIP circuit provides a bucking voltage to prevent the speaker output from tripping the transceiver into the transmit mode. The receiver audio output is connected through the ANTITRIP potentiometer, VR_{601}, to the antitrip amplifier, Q_{605}, **2SC372Y** and rectified by D_{602}, 1N60 to produce positive DC voltage at the base of Q_{606}, **2SC373**. When there is no antitrip input Q_{606} will be off as will Q_{607}, **2SA564A**.

On receive, signal comes into pin 6 of the VOX UNIT and Q_{606} and Q_{607} will conduct causing the collector voltage of Q_{607} to increase, thus maintaining Q_{604} in an off state on receive mode. This provides the necessary antitrip threshold.

Input signal from the mike will turn Q_{603} on, discharging C_{613}, yet the input of Q_{604} will be kept in HIGH level preventing the transceiver from tripping, thus providing very stable VOX operation.

As the input to the mike stops, Q_{603} will become off and C_{613} will be charged according to the time constant set up by VR_{602} and R_{623}. When the input voltage of Q_{604} reaches the preset level, the output will become off, thus returning the unit to receive mode.

The VOX GAIN control (VR1) on the front panel provides adjustment for relay sensitivity, and VR_{601} for antitrip sensitivity. Relay hold time is determined by the delay control, VR_{602}.

The tone oscillator, Q_{609}, **2SC373** operates when the MODE switch is in the CW position. It is a phase-shift oscillator operating at approximately 800 Hz.

The tone output is activated by the keying circuit through the emitter of Q_{609} and coupled to the base of Q_{602}, **2SC373** for break-in CW operation. The output is also fed to the base of Q_{506} in the AF UNIT through VR_{603} for CW monitoring. The VR_{603} adjusts the sidetone level.

(3) MARKER CIRCUIT

Located on the VOX UNIT (PB-1438), the crystal marker generator, Q_{610}, **2SC735Y** generates a basic 1 MHz signal, with its output fed through a buffer amplifier Q_{611}, **2SC735Y** to a frequency divider Q_{612}, **34013PC**. The divider output provides either 100 kHz or 25 kHz marker signals as selected by S601 for dial calibration of the FT-301.

The marker signals are then fed to the antenna input from pin 3 of the VOX UNIT' TC_{601} is used to set the 1 MHz basic oscillator precisely to WWV or JJY.

Q_{608}, **2SC372Y** is to stabilize the 8.5V DC power supply to the VOX and sidetone generator.

VFO UNIT (PB-1440)

A modified Colpitts type oscillator is used to generate a 5.0 MHz to 5.5 MHz signal to produce a stable 500 kHz tuning range. The frequency is varied by VC_{801} which is geared to a precision built dial tuning mechanism.

The VC_{801} consists of two sections. The sub blades compensate the capacitance variation of the main blades caused by temperature changes. Frequency drift is minimized through the use of a temperature compensation circuit utilizing a differential trimmer capacitor, TC_{801}.

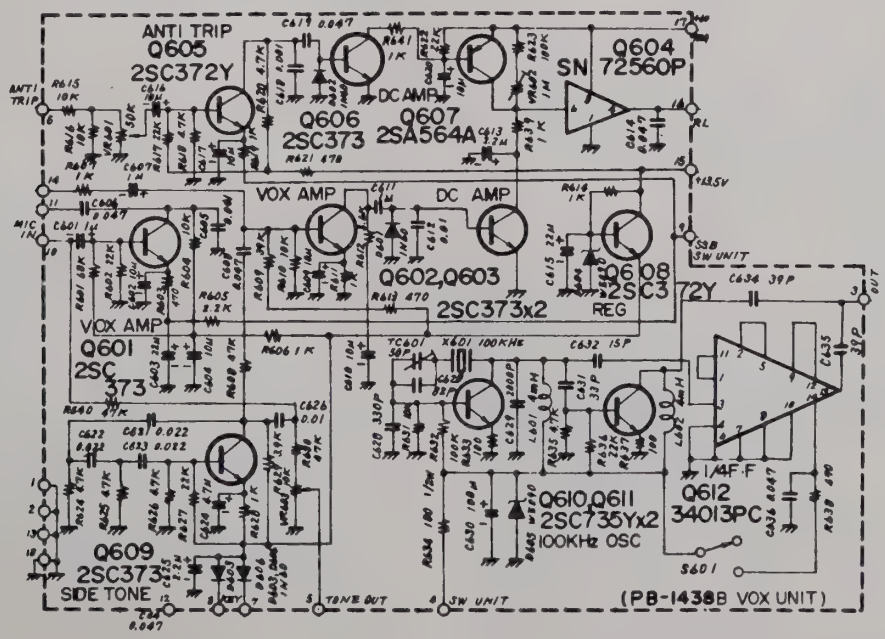


Figure 23 VOX Unit (PB-1438)

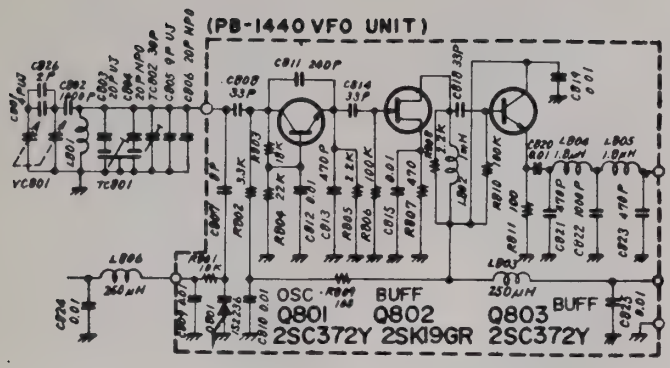


Figure 24 VFO Unit (1440)

The varactor diode D_{801}, **1S 2236** is in series with C_{807}, and the combination is in parallel with VC_{801}. By closing the clarifier switch S_{1805}, a portion of the regulated 6V is applied, shifting the frequency ±3 kHz, depending on the setting of clarifier control VR5. The VR_{1902} on PB-1451 blanking unit is used to establish the zero set for the clarifier.

The VFO output signal is fed through the amplifier/buffer stage, Q_{802}, **2SK19GR** and Q_{803}, 2SC372Y, and the low pass filter to the OUT terminal. From there, the signal goes to the PRE-MIX UNIT.

FIX UNIT (PB-1447)

In addition to normal VFO operation, 11 crystals may be used for crystal controlled operation. The selector switch located on the front panel of the transceiver selects the crystal in use. The trimmer capacitors, TC_{1501} – TC_{1511}, are for fine adjustment of each crystal frequency.

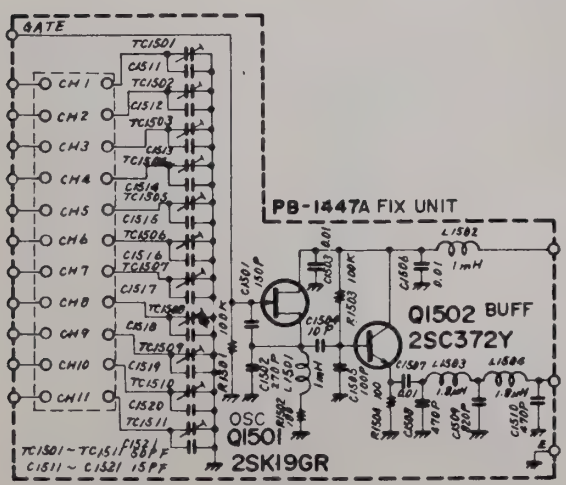


Figure 25 FIX Unit (PB-1447)

The FIX channel crystal oscillator Q_{1501}, **2SK19GR** oscillates at the frequency of the crystal selected by the CHANNEL switch. The frequencies of the crystals must fall between 5.0 MHz – 5.5 MHz.

The crystal signal is fed through the amplifier/buffer stage Q_{1502}, **2SC372Y** and a low pass filter to the OUT terminal on PB-1447 (FIX UNIT).

PRE-MIX UNIT (PB-1439) CRYSTAL UNIT (PB-1441) & BPF UNIT (PB-1442)

The FT-301 transceiver utilizes a unique technique of premix to minimize the signal distortion. The VFO signal is premixed with a local crystal oscillator signal and then fed to the mixer stages of the transmitter and receiver.

Crystal oscillator Q_{702}, **2SC372Y** produces a heterodyne signal selected by the band switch. The signal is fed to the double balanced mixer Q_{701}, **MC1496G** where the signal is mixed with a signal from the VFO or FIX oscillator to produce the local signal for each band. The local signal is then fed to the wideband buffer amplifier stage Q_{705}, **2SK19GR**, Q_{704} and Q_{703}, **2SC784R** through the bandpass filter unit (PB-1442). The local signal or the premix output is obtained at J701.

For 80 meter, the VFO signal is directly coupled, through the buffer stage, to the transmitter and receiver mixer in the RF unit.

For reception of WWV, a 13.9985 MHz crystal is used for the crystal oscillator Q_{702}. The 5 MHz standard signal may be heard with zero beat without use of the VFO. The BAND switch must be set to WWV/JJY and the MODE to LSB.

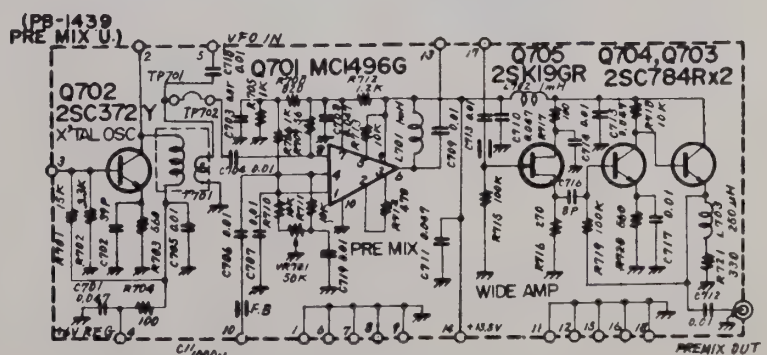


Figure 26 PREMIX UNIT (PB-1439)

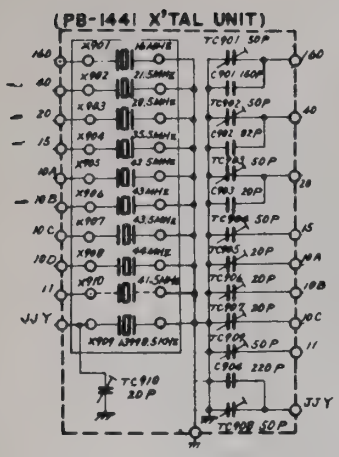


Figure 27
Crystal unit (PB-1441)

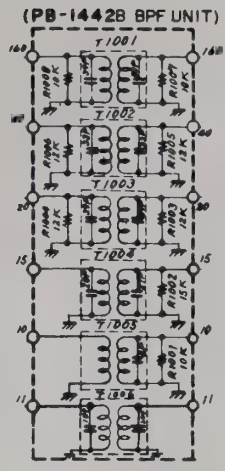


Figure 28
BPF Unit (PB-1442)

The frequency relation of the FT-301 is shown in Table 2.

Band	Frequency	Crystal	Premix out
160m	MHz MHz 1.5~ 2.0	MHz 16.0	MHz MHz 10.5~11.0
80m	3.5~ 4.0	—	5.5~ 5.0
40m	7.0~ 7.5	21.5	16.0~16.5
20m	14.0~14.5	28.5	23.0~23.5
15m	21.0~21.5	35.5	30.0~30.5
11m	27.0~27.5	41.5	36.0~36.5
10mA	28.0~28.5	42.5	37.0~37.5
10mB	28.5~29.0	43.0	37.5~38.0
10mC	29.0~29.5	43.5	38.0~38.5
10mD	29.5~30.0	44.0	38.5~39.0
JJY	5.0	13.9985	13.9985

Table 2 VFO: 5.0~5.5MHz IF: 9MHz

A study of the block diagram on Page 12 will also prove useful in tracing the various signal paths through the transceiver.

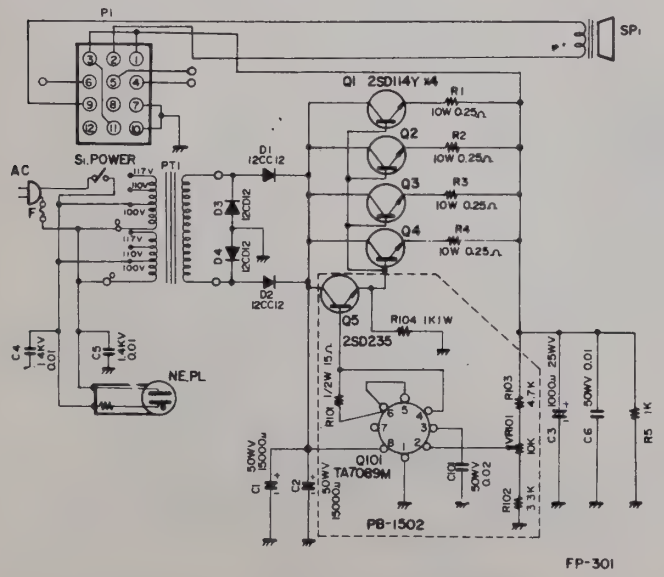


Figure 29 **FP-301 Circuit Diagram**

AC POWER SUPPLY

The FP-301 AC power supply is designed for base operation of the FT-301 SSB transceiver. However, this high current regulated power supply can also be used for other purposes such as when there is a requirement for a regulated 13.5 volt DC supply from AC power sources.

MODEL	SPECIFICATIONS
FP-301	Output 13.5V DC – Max 25 Amps for FT-301 or FT-301D
FP-301D	Output 13.5V DC – Max 25 Amps for FT-301 or FT-301D with automatic ID and digital clock

CIRCUIT DESCRIPTION

The power supply is designed to operate from either 100, 110, 117, 200, 220 or 234 Volts AC, 50 or 60 Hz.

A transformer is energized by two primary windings which can be connected in series for 200, 220 and 234 Volts and in parallel for 100, 110 and 117 Volts operation. A secondary output voltage is rectified by a full wave bridge rectifier consisting of diodes, D_1, D_2, D_3 and D_4, 12CD12.

The rectified DC voltage is stabilized by a voltage regulator consisting of Q_1 through Q_4, **2SD114Y**, Q_5, **2SD235** and Q_{101}, **TA7089M**.

The regulator Q_{101} works as a current limiter to protect the over current failure of the regulator transistors.

The FP-301D has a built-in digital clock and automatic identification circuits. The digital clock displays the time in hours, minutes and seconds and is synchronized to the supply voltage frequency, 50 Hz or 60 Hz. The frequency can be selected by changing the internal windings. The display can be selected for either a 24-hour or 12-hour system with a switch at the front panel.

The call sign for automatic ID will be programmed into an integrated circuit by our authorized dealer at a minimum cost.

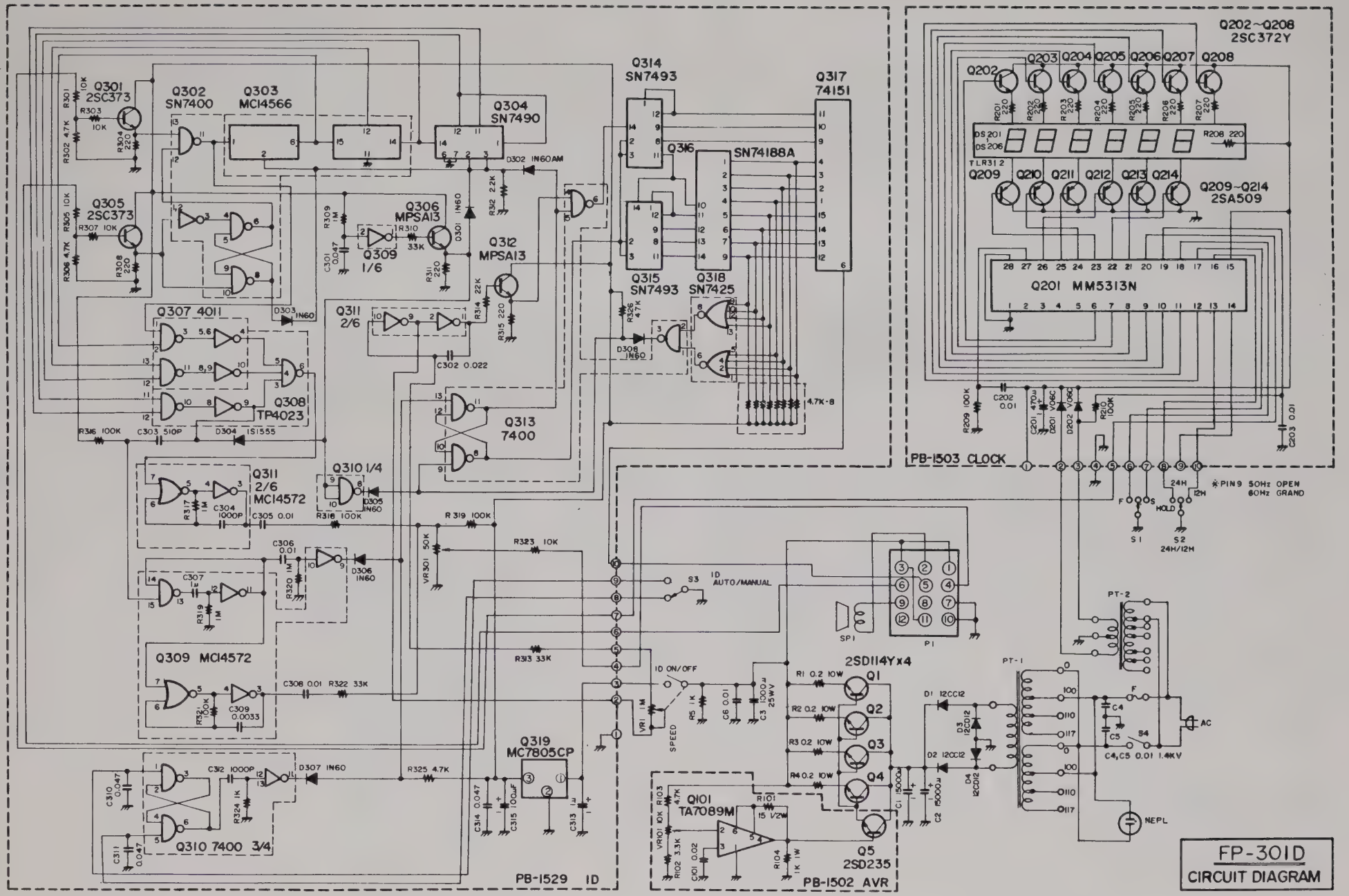


Figure 30 FP-301D Circuit Diagram

FREQUENCY COUNTER UNITS

A frequency counter is incorporated for accurate and easy frequency readout by the display diode.

The frequency readout unit consists of a counter unit, frequency converter unit and a display unit by LED (Light Emitting Diode) to display operating frequency in the dial window.

The counter device utilizes LED to display the lowest digit of 100 Hz, however, the counter unit counts to 10 Hz to avoid the annoyance of flicker of the last digit.

The diode matrix circuit selects MHz display which corresponds to the setting of the BAND switch. The VFO frequency of 5 to 5.5 MHz is connected to 13.0 – 13.5 MHz and the counter counts this frequency.

COUNTER MIXER UNIT (PB-1541)

The heterodyne oscillator Q_{2202}, **2SK19GR** oscillates at 18.5 MHz crystal frequency. A varactor diode, D_{2211}, **1S2209** is connected in series with a crystal and shifts the crystal frequency to calibrate frequency from front panel. The varactor diode voltage is supplied through the potentiometer marked CA4B. The oscillator output is fed through a buffer amplifier Q_{2204}, **2SK19GR** to the mixer, Q_{2203}, **SN76514** where the incoming VFO from pin 5 of printed board is heterodyned to 13.0 – 13.5 MHz signal.

The diode matrix circuit consists of a read memory IC, Q_{2201}, **MSL-980Y2** and diodes D_{2201} – D_{2210}, 1N60AM for preset counter adding 500 kHz to the VFO frequency and for 7 MHz, 5 MHz, 10 MHz and 20 MHz display.

The diodes are grounded by the BAND switch in order to make BCD input terminal "L". The matrix circuit is so composed that unnecessary BCD code is grounded as BCD input of Q_{2101} – Q_{2106} are "H" level.

Q_{2106}, **TIL308** is only used to display 1 or 2 for 10 MHz and 20 MHz so that A or B of BCD input terminal is set to "H" through inverter Q_{2112}, **SN7404** for 10 or 20 MHz display.

For 5 MHz JJY or WWV signal, the counter displays 5,000 kHz, regardless of VFO frequency, by closing gate 1 of the counter input.

The clock signal is oscillated by C MOS IC Q_{2204}, **MSM5564** which also contains 18 stages of the binary counter. The 655.36 kHz signal is then divided by the binary counter into a 5 Hz signal which is amplified by a buffer amplifier Q_{2205}, **2SC373** and is used as a gate signal for counter gate 2.

DISPLAY LOGIC UNIT (PB-1542)

The heterodyned 13.0 – 13.5 MHz signal is wave shaped and inverted by Q_{2110}, **SN7404N** and then fed to gate 1 of Q_{2109}, **SN7400N**. Gate 1 closes when the BAND switch is set to JJY/WWV position but opens for other positions.

Gate 2 is controlled by a 5 Hz gate signal and counts the number of pulses passing through the gate. The output from Q_{2109} is then fed to Q_{2107}, **SN7490N** which counts 10 Hz. Q_{2107} generates a pulse each time it counts 10 pulses.

This pulse is fed to Q_{2101} which displays a 100 Hz digit. The pulse is also used as a clock pulse for Q_{2102}, Q_{2103} and Q_{2108} to count 1 kHz, 10 kHz and 100 kHz pulses.

Q_{2101} – Q_{2103}, **TIL306** contains counter, latch decoder, driver and LED in one package. Q_{2108}, **SN74160** is used as a preset counter to add 500 kHz for such bands starting from 800 kHz. The BCD code output from Q_{2108} is fed to Q_{2104}, **TIL308**. **TIL308** does not contain counter circuit. Q_{2112}, **SN7404N** is used as inverter. A part of gate pulse is fed to Q_{2111}, **SN7400N** to generate reset and memory signals.

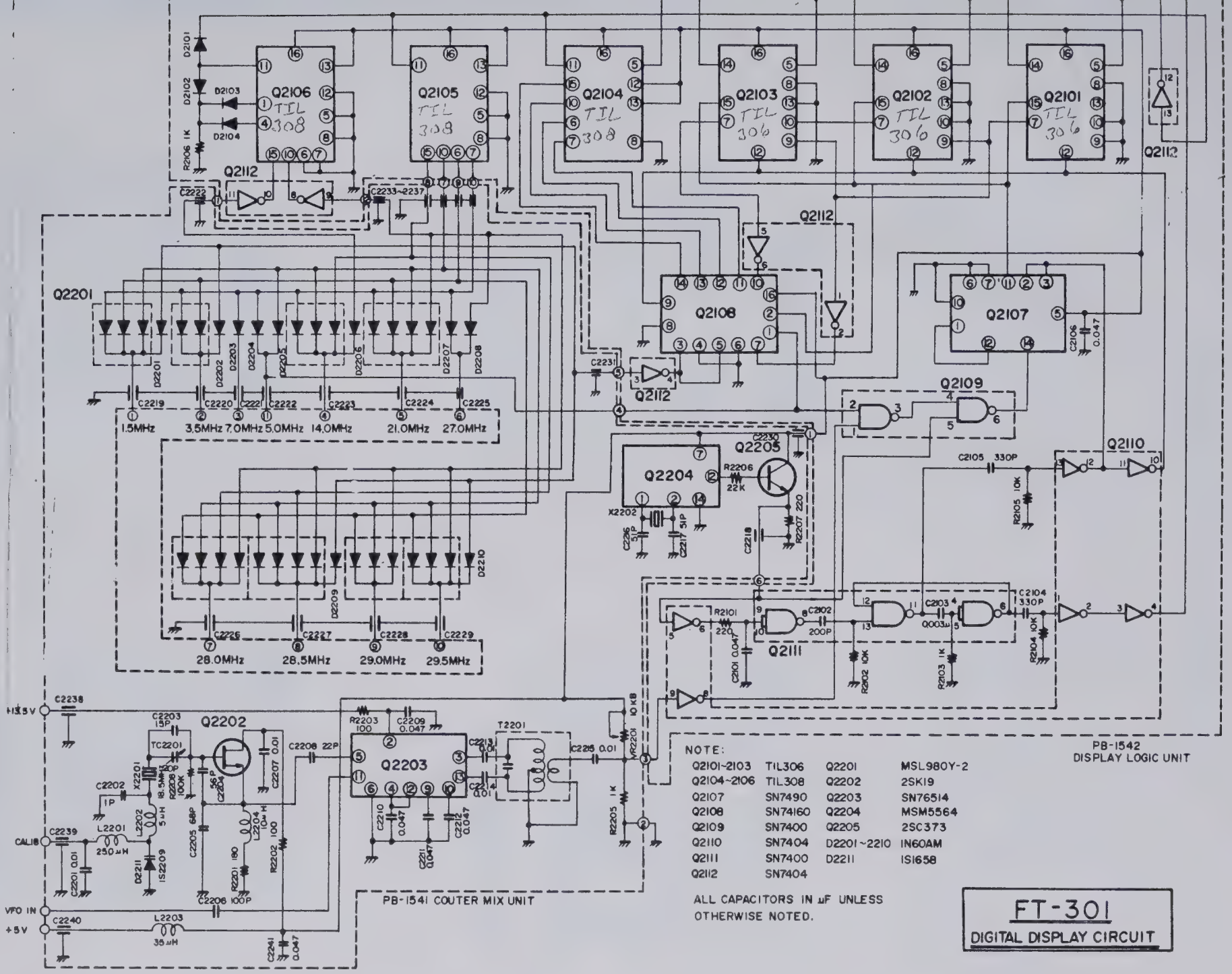


Figure 31 Digital Display Circuit (Counter Mixer Unit, Logic Display Unit)

GENERAL

This transceiver has been carefully aligned and tested at the factory prior to shipment. The reliability of the solid state devices used in the FT-301 should provide years of trouble-free service if the equipment is not abused and proper routine maintenance carried out.

Do not attempt to align the transmitter without having the proper antenna or a dummy load connected to the transceiver. We recommend off the air testing as a courtesy to other operators.

The following alignment procedure requires certain test equipment such as an RF signal generator, an audio oscillator, a sweep generator, an oscilloscope and a VTVM. Without proper test equipment, do not attempt to adjust cores or potentiometers.

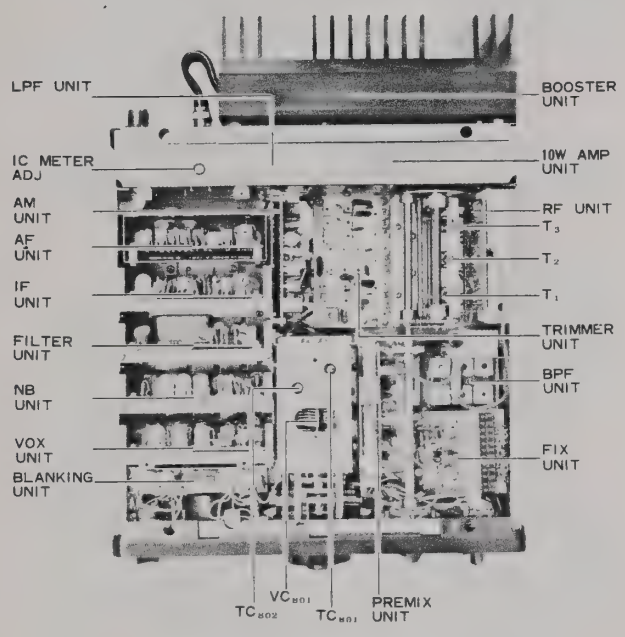


Figure 32 FT-301 Top View

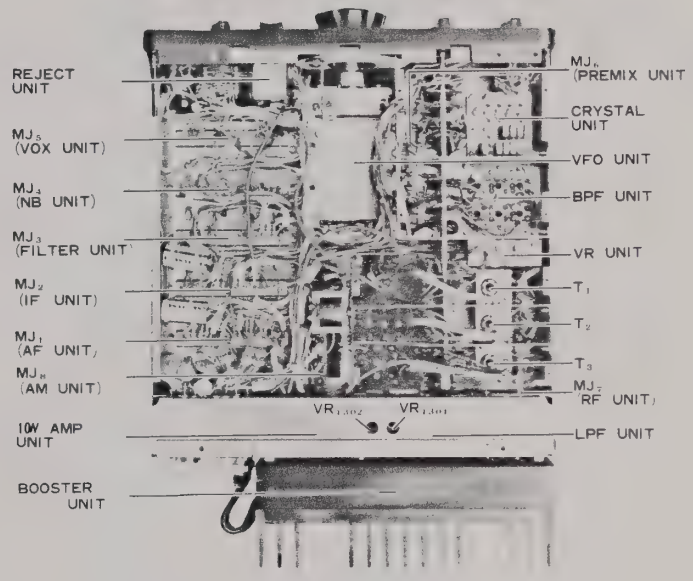


Figure 33 FT-301 Bottom View

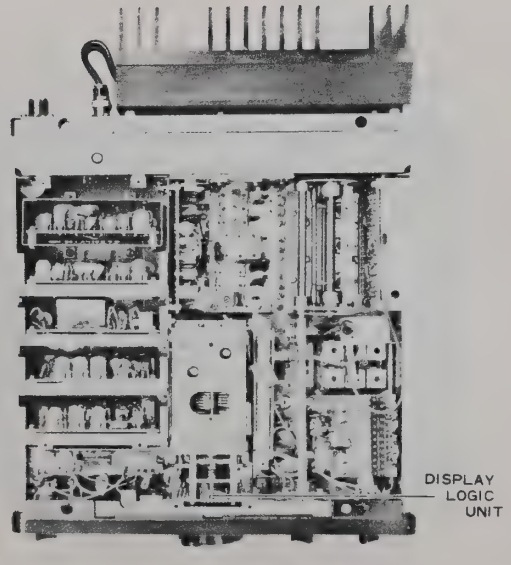


Figure 34 FT-301D Top View

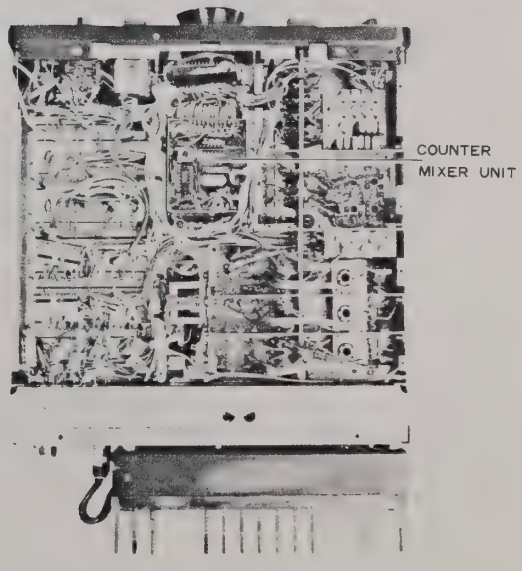


Figure 35 FT-301D Bottom View

AF UNIT

(1) SSB CARRIER POINT ADJUSTMENT (TC501, TC502)

(a) Settings:

BAND 20

DIAL ..... 14.25 MHz

MODE ..... CW

Tune to transmit at the maximum power.

(b) Connect the output of an audio oscillator to the microphone input. Set the frequency at 1 kHz and transmit on USB. Adjust the MIC GAIN control for 50 watts RF output to the dummy load.

(c) Shift the audio frequency to 300 Hz without changing the audio output level or MIC GAIN control.

(d) Switch between USB and LSB while adjusting TC_{501} for USB and TC_{502} for LSB to obtain 12.5 watts output on each sideband. (For the 80 meter band, USB and LSB will reverse but you are on 20 meters now.)

(e) Return to receive mode. Switch the MODE selector back and forth between USB and LSB to verify that the tone quality of the noise on the two sideband modes sounds alike.

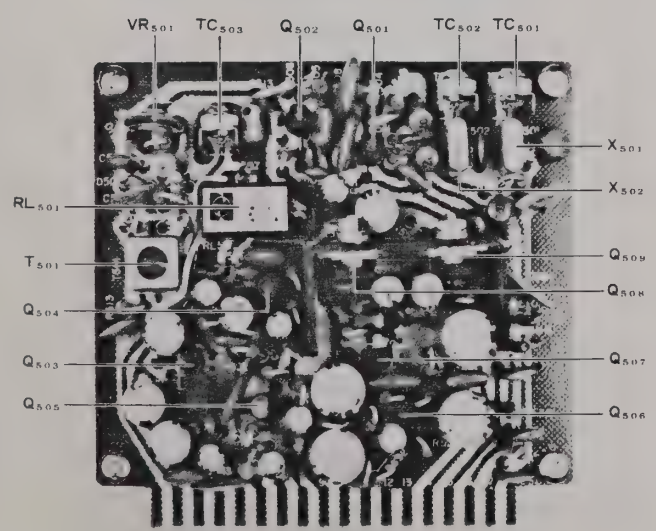


Figure 36 AF Unit (PB-1437)

(2) CARRIER BALANCE

(a) Settings:

BAND 20

DIAL ..... 14.25 MHz

MODE ..... USB

No input to the mike jack.

(b) Connect a dummy load to the antenna receptacle and the RF probe of a VTVM to the antenna receptacle, J1. Adjust TC_{503} and VR_{501} alternately to minimize the VTVM reading.

(c) If no VTVM is available, use a monitor receiver and adjust TC_{503} and VR_{501} for the minimum S meter reading.

(d) Repeat this procedure until a minimum reading is obtained equally for both sidebands.

FILTER UNIT, IF UNIT

IF GAIN (VR_{301}), S METER ZERO SET (VR_{401}) S METER FULL SCALE SET (VR_{402})

(a) Settings:

BAND 20

DIAL ..... 14.25 MHz

TUNE ..... 20 METER

SELECT ..... INT

CHANNEL ..... VFO

RF GAIN ..... MAX
(FULLY CLOCKWISE)

Connect the output to a stable signal generator to the antenna receptacle. Set the signal generator output to 0 dB and frequency to other than 14.25 MHz.

(b) Set VR_{402} to a fully clockwise position. Adjust VR_{401} until the S meter indicates zero.

(c) Set the generator frequency to 14.25 MHz at 0 dB output. Adjust the TUNE and DIAL for maximum sensitivity, then adjust VR_{301} until the S meter again indicates zero.

(d) Increase the generator output to 80 dB. Adjust VR_{402} for a full scale indication of the S meter.

(e) Repeat above procedures as required to achieve correct zero and maximum indications.

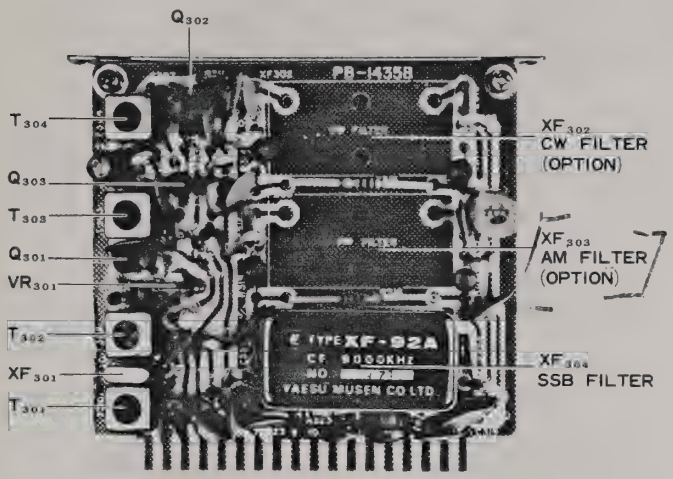


Figure 37 Filter Unit (PB-1435)

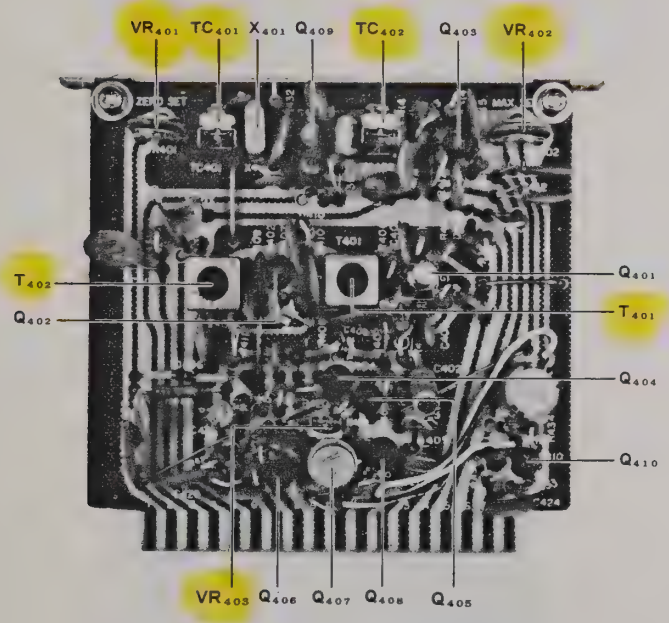


Figure 38 IF Unit (PB-1436)

VOX UNIT

(1) ANTITRIP INPUT LEVEL (VR_{601})

(a) Tune in a signal on SSB and adjust the AF GAIN control to a normal listening level.

(b) With microphone positioned near the speaker, increase VOX GAIN control until it switches to transmit automatically.

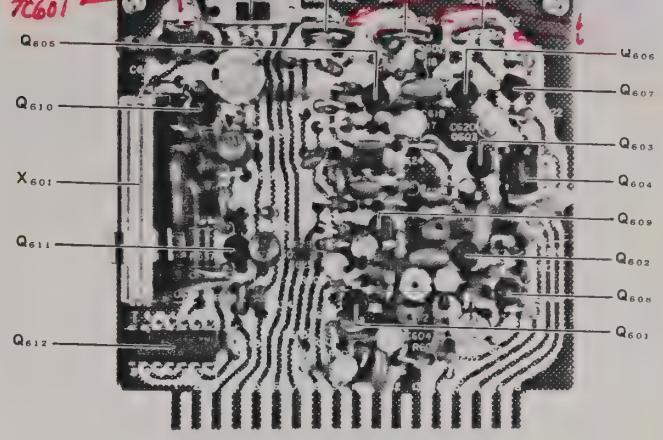


Figure 39 VOX Unit (PB-1438) (Option)

(c) Set the ANTITRIP control VR_{601} to the minimum point that will prevent the speaker output from tripping the VOX relay.

(d) Speak into the microphone normally to see if it activates the relay to transmit mode. If not, VR_{601} may be turned too far.

(2) VOX DELAY TIME (VR_{602})

(a) Adjust the delay control, VR_{602}, for suitable release time. Turning clockwise will give a longer delay time and counter-clockwise will give a shorter delay time.

(b) For a break-in CW operation, VR_{602} should be adjusted for a suitable delay time as well.

(3) CW SIDETONE LEVEL

In CW operation, the sidetone circuit is activated for monitoring and the CW sidetone level may be adjusted with potentiometer VR_{603}.

(4) MARKER GENERATOR FREQUENCY (TC_{601})

(a) Settings:

BAND ..... JJY/WWV

TUNE 2

MODE ..... LSB

(b) Receive WWV with zero beat by adjusting TC_{901} on the crystal unit.

(c) Turn the MARKER switch on and zero beat the marker signal against WWV by adjusting TC_{601}.

RF SPEECH PROCESSOR

The optional crystal filter XF_{201} is required to operate with the RF SPEECH processor.

(1) Level adjustment when the processor is used (VR_{202}, VR_{203})

(a) Adjust the MIC GAIN control to a proper setting. Refer to blanking unit adjustment on Page 31.

(b) Apply a 2 mV, 1 kHz signal to the mike input jack.

(c) Connect a VTVM to pin 11 of the FILTER unit while VR_{203} is turned fully clockwise.

(d) Adjust VR_{202} so that the VTVM reads 40 mV.

(2) Level adjustment when the processor is "off" (VR_{201})

Turn the RF PROC switch "off" and adjust VR_{201} so that the VTVM reads 40 mV.

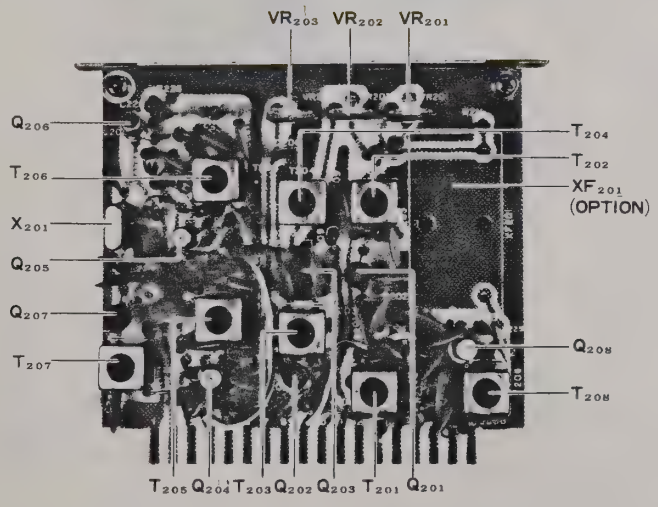


Figure 40 NB Unit (PB-1434)

VFO UNIT

It requires skilled technique and knowledge to align the VFO unit. It is, therefore, recommended to refer all VFO work to qualified personnel should a case develop where a repair is needed on the VFO unit.

TC_{801} .... A split type trimmer capacitor for temperature compensation.

TC_{802} .... Band setting trimmer capacitor.

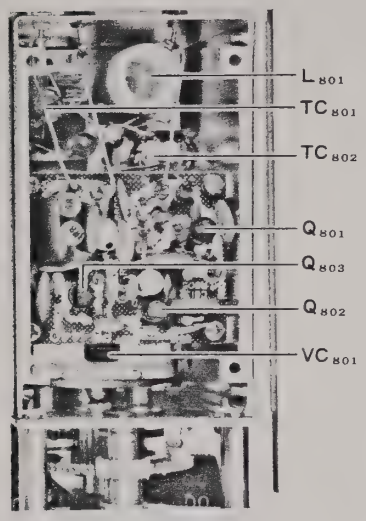


Figure 41 VFO Unit

PREMIX UNIT, CRYSTAL UNIT

The 160 mA, 10 mA, 10 mD and WWV crystals are optional and their corresponding fine frequency setting trimmers have been factory adjusted with the standard crystals.

PREMIX CRYSTAL OSCILLATOR (T_{701}, TC_{901} – TC_{910})

When optional crystals are installed, no alignment of T_{701} is required. Should T_{701} need an adjustment for some reason, all other trimmers (TC_{901} – TC_{910}) have to be realigned.

(a) To align T_{701}, set the BAND switch to 10D and connect the RF probe of a VTVM to TP_{701} of the PREMIX unit (junction of C_{718} and C_{704}).

(b) Peak T_{701} for a maximum VTVM reading, and then rotate the core counter clockwise until the VTVM reading indicates 50 mV. (Do not rotate the core more than one full turn.)

(c) Set the BAND switch to 10C and adjust TC_{907} for a 50 mV reading.

(d) Repeat the same procedure as step (c) on TC_{906} – TC_{901} for 10B through 160 meter bands respectively so that the VTVM readings indicate 50 mV. (There is no trimmer capacitor for the 80 meter band.)

(e) Set the BAND switch to JJY/WWV. Preset TC_{901} to its mid point (at half capacitance) and adjust TC_{908} for a 100 mV VTVM reading. Set the MODE to LSB and the TUNE to 2 of the unity scale, and then adjust TC_{910} for a zero beat reception of WWV.

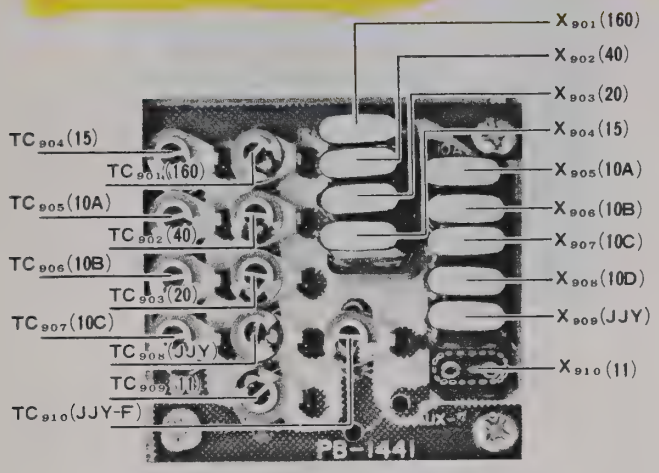


Figure 42 Crystal Unit (PB-1441)

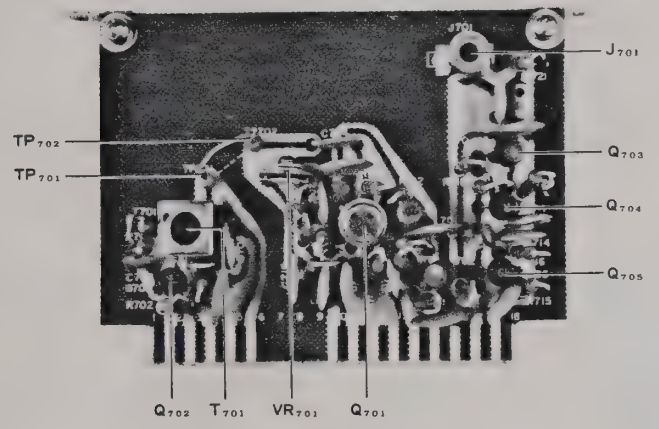


Figure 43 PREMIX Unit (PB-1439)

BPF UNIT (PB-1442)

(1) BANDPASS FILTER (T_{1001} – T_{1005})

The adjustment of the bandpass filters is critical to the spurious response. It requires a sweep generator and a scope for proper alignment.

(a) Remove the jumper wire between TP_{701} and TP_{702} on the PREMIX unit. (TP_{702} is not shown on schematic, refer to Fig. .)

(b) Connect the output of a sweep generator to TP_{702} and the RF probe of a scope to TP_{701}.

(c) Set the VFO SELECT to EXT to disconnect the VFO from the circuit. Apply 30 dB sweep output to TP_{702}.

(d) Monitor the wave patterns on the scope by offsetting the balancing pot VR_{701} on the PREMIX UNIT.

(e) Adjust T_{1001} – T_{1005} so that the passband characteristics become as flat as possible within the passband range specified.

BAND	BPF PASSBAND
160	10.5 – 11.0 MHz
40	16.0 – 16.5 MHz
20	23.0 – 23.5 MHz
15	30.0 – 30.5 MHz
10	37.0 – 39.0 MHz

(f) When completed, re-install the jumper wire between TP_{701} and TP_{702}.

(2) PREMIX BALANCE (VR_{701})

(a) Set the BAND switch to 10 mD. Connect the RF probe of a VTVM to the pinjack, J_{701}, and adjust VR_{701} for a minimum reading.

(b) Return the VFO SELECT to INT and make sure that the VTVM reading indicates between 0.7 – 0.9V.

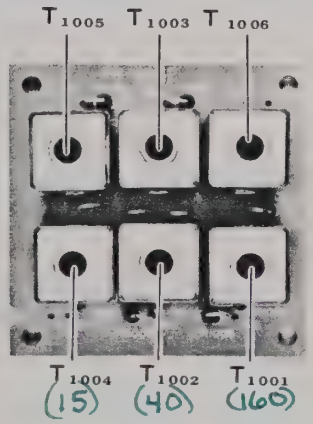


Figure 44 BPF Unit (PB-1442)

FIX UNIT (PB-1447)

The trimmer capacitors TC_{1501} – TC_{1511} are provided for fine frequency tuning of fixed channel crystals. The 12th socket is for auxiliary and it is not connected to the switch.

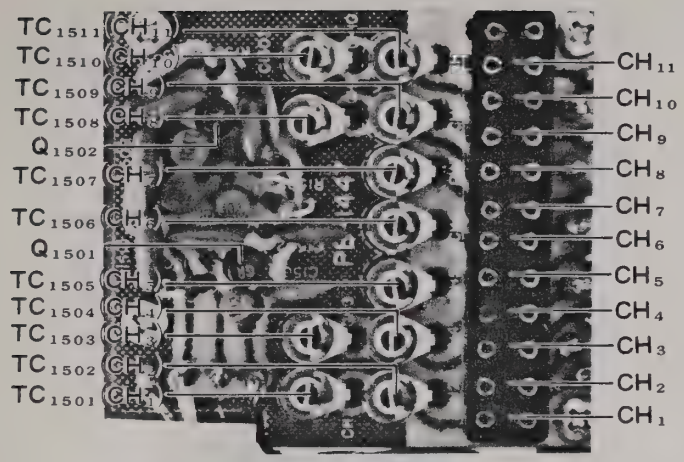


Figure 45 Fix Unit (PB-1447)

RF UNIT (PB-1433)

(1) TRANSMITTER MIXER BALANCE (VR_{101})

(a) Transmit on the 80 meter band in CW mode with the TUNE set to 6 of the unity scale.

(b) Adjust VR_{101} for a minimum power output.

(2) RECEIVER MIXER (T_{102})

Tune the transceiver to the internal marker signal and peak T_{102} for a maximum S meter indication.

(3) 9 MHz TRAP (T_{101}, T_{1401})

(a) Set the BAND switch to the 40 meter band and tune the transceivr for maximum sensitivity with the TUNE control.

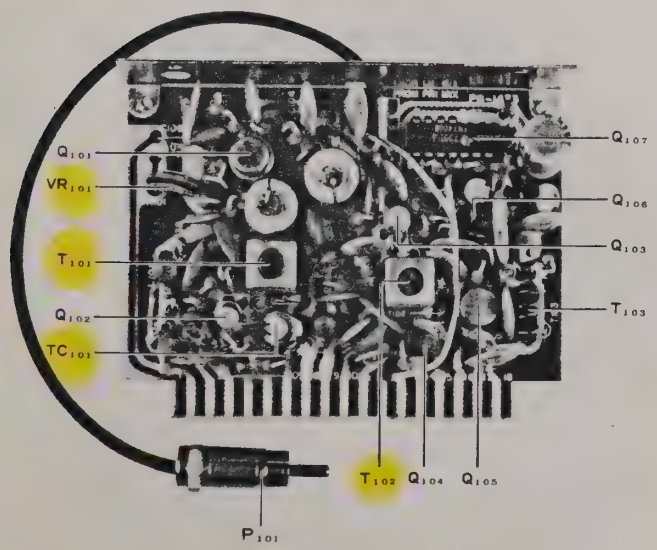


Figure 46 RF Unit (PB-1433)

(b) Connect the output of a signal generator set to exactly 9 MHz, and apply enough output so that the S meter indicates S6 – S8.

(c) Adjust T_{101} on the RF UNIT and T_{1401} on the TRIMMER UNIT for a minimum S meter reading.

(d) Increase the output of the generator and repeat step (c) until the lowest S meter reading is achieved.

BLANKING UNIT

(1) SETTING OF MIC VR (VR_{1901})

(a) Connect the output of an audio generator to the mike input jack and a VTVM to pin 5 of the IF unit. Tune the transceiver to transmit on the 20 meter band in USB.

(b) Transmit with a signal input of 2 mV at 1 kHz and adjust the MIC GAIN control, VR_{1901}, for an 80 mV VTVM reading.

(c) If using a microphone other than the one furnished with the unit, it will be necessary to readjust the MIC GAIN control.

(2) CLARIFIER ZERO SETTING (VR_{1902})

(a) Tune the transceiver to the marker or signal generator on any band.

(b) Set the clarifier control to its centre (12 o'clock position). With the CLAR switch turned on, tune the dial for zero beat.

(c) Turn the CLAR switch off and zero beat by adjusting VR_{1902}.

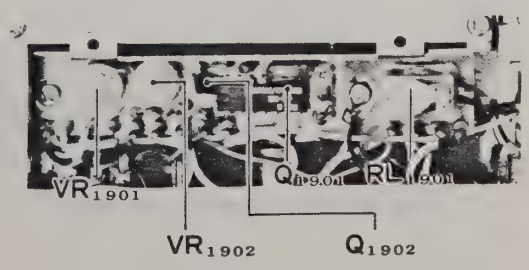


Figure 47 Blanking Unit (PB-1451)

LPF UNIT (PB-1445)

(1) BALANCING OF OUTPUT DETECTOR TRANSFORMER (TC_{1301})

(a) Set the ALC level control, VR_{1302} to fully clockwise position. Connect a dummy load to antenna terminal and time the transmitter to full output on CW mode at 80 meter band.

(b) Peak TC_{1301} for a maximum power output.

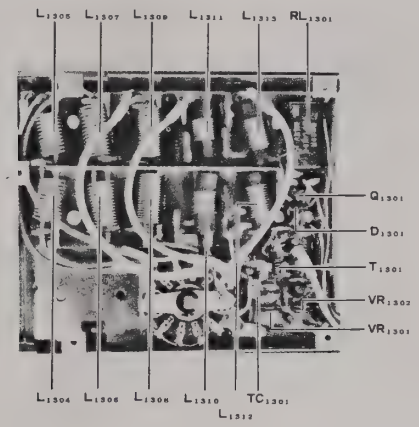


Figure 48 LPF Unit (PB-1445)

(2) ALC LEVEL (VR_{1302})

(a) Transmit on the 80 meter band as described above. Slowly advance VR_{1302} in a counter-clockwise direction and set the VR_{1302} to the point where the power output starts to decrease.

(b) A care must be taken when adjusting VR_{1302} as a high SWR due to the antenna mismatch will cause improper setting of VR_{1302}.

(3) OVERDRIVE PROTECTOR (VR_{1301})

(a) Transmit on the 20 meter band in CW with 100 watts output.

(b) Change the MODE switch to USB and while speaking into the microphone normally, rotate VR_{1301} slowly until the protection circuit activates. This will be indicated by blinking of the S meter lamp.

(c) Stop transmitting, then return the control counter-clockwise 1/8 of a turn. This point is the proper setting for the overdrive protection circuit. Be sure not to return the control more than specified.

(d) Turn the POWER switch off once to restore a normal condition.

VR UNIT (PB-1448)

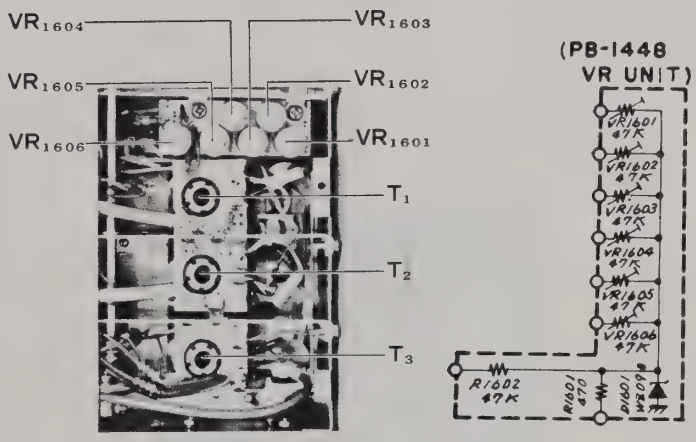
(1) EXCITER, DRIVE LEVEL (VR_{1601} – VR_{1606})

(a) Settings:

BAND	160 M
DIAL	500 (on white scale)
TUNE	160 METER
DRIVE	Fully clockwise
MODE	CW
VR_{1302} on the LPF unit ...	Fully clockwise

(b) Adjust the TUNE control for a peak output while transmitting. Adjust VR_{1601} for 100 watts output. It is necessary to retune the TUNE control as you adjust VR_{1601}.

(c) Switch the BAND from 80m through 10D and repeat the same procedure as step (b) for the corresponding potentiometers VR_{1602} – VR_{1606} for 100 watts output.



VR Unit (PB-1448) Figure 49

AM UNIT (PB-1556)
AM Unit (PB-1556)

(1) AM CARRIER FREQUENCY (TC_{2001})

(a) Connect a frequency counter to pin 2 of multi-connector.

(b) Set the MODE switch to AM position and key the transmitter.

(c) Adjust TC_{2001} until crystal frequency becomes 8999.3 kHz.

(2) **FSK SHIFT FREQUENCY (TC_{2002})**

(a) Connect a frequency counter to pin 2 of multi-connector.

(b) Set the MODE switch to FSK position and key the transmitter. Adjust TC_{2002} until crystal frequency shift is 170 Hz (8999.13 kHz) when pin 3 and pin 6 of accessory socket are connected.

(3) **AM OUTPUT LEVEL (VR_{2001})**

Set the BAND switch to 10B, MODE switch to AM and DRIVE control to fully CW position. Key the transmitter and adjust VR_{2001} for 25 watts output.

Figure 50 AM Unit (PB-1556)

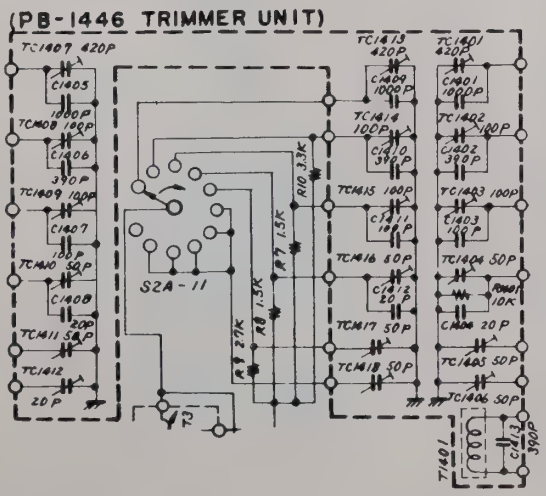


Figure 51

(4) **AM MIC GAIN (VR_{2002})**

Observe the transmitted signal on oscilloscope and adjust VR_{2002} for 100% modulation.

RF TRACKING

Preselector Coils (T_1–T_3) and Trimmer Unit (TC_{1401}–TC_{1418})

(a) Turn the TUNE control fully counter-clockwise and make sure that the knob indicates 0 on the unity scale. At 3.5 of the unit scale, the upper ends of the cores and the coil bobbins should line up with each other.

(b) Set the BAND switch to 10 mD, the VFO to 30 MHz, and the TUNE control to the upper end of 10m segment (9.5 of the unity scale), then adjust TC_{1412} and TC_{1418} on the TRIMMER UNIT for maximum power output.

(c) After completing step (b), return to receive mode and adjust TC_{101} on the RF UNIT for maximum sensitivity. Do not change the VFO and TUNE settings once set up in step (b).

(d) Set the BAND switch to 80m, the VFO to 3.5 MHz, and the TUNE control to the lower end of 80m segment (3 of the unity scale), then adjust TC_{1408} and TC_{1414} for the maximum power output. Return to receive mode and adjust TC_{1402} for maximum sensitivity.

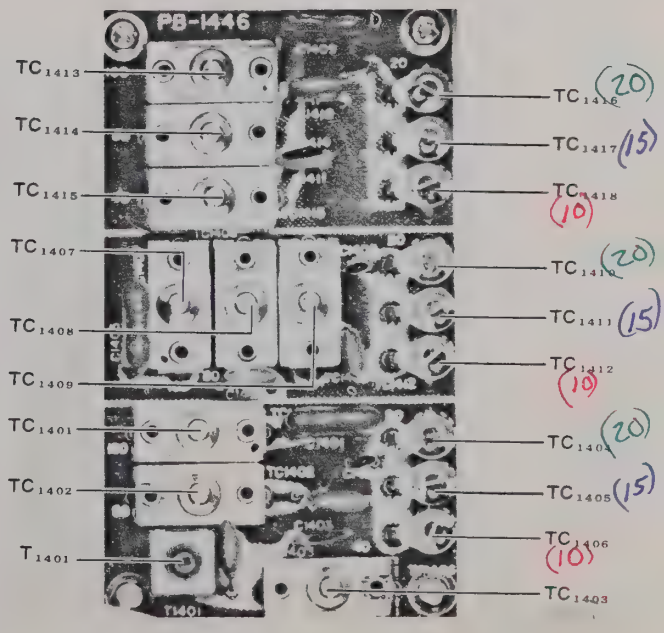


Figure 52 Trimmer Unit (PB-1446)

(e) Shift the VFO to 4.0 MHz and the TUNE control to the upper end of 80m segment (4.1 of the unity scale), then adjust T_2 and T_3 for maximum power output. Return to receive and adjust T_1 for maximum sensitivity.

(f) Repeat steps (d) and (e).

(g) Repeat steps (b) and (c) and readjust TC_{1406}, TC_{1412}, TC_{1418} and TC_{101}.

(h) Set the BAND switch to 15m, the VFO to 21.0 MHz and the TUNE control to 7.5 of the unity scale. Then adjust TC_{1405}, TC_{1411} and TC_{1417} for maximum receive and transmit.

(i) Set the BAND switch to 20m, the VFO to 14.0 MHz and the TUNE control to 6.5 of the unity scale. Then adjust TC_{1404}, TC_{1410} and TC_{1416} for maximum receive and transmit.

(j) Set the BAND switch to 40m, the VFO to 7.0 MHz and the TUNE control to 5 of the unity scale. Then adjust TC_{1403}, TC_{1409} and TC_{1415} for maximum receive and transmit.

(k) Set the BAND switch to 160m, the VFO to 2.0 MHz and the TUNE control to 3 of the unity scale. Then adjust TC_{1401}, TC_{1407} and TC_{1413} for maximum receive and transmit.

When completed, replace all shields, covers, etc. removed for access to the various adjustments and test points.

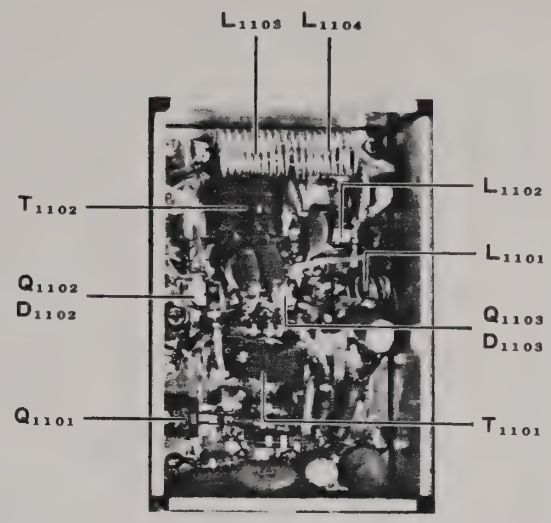


Figure 53 10W Amp Unit (PB-1443)

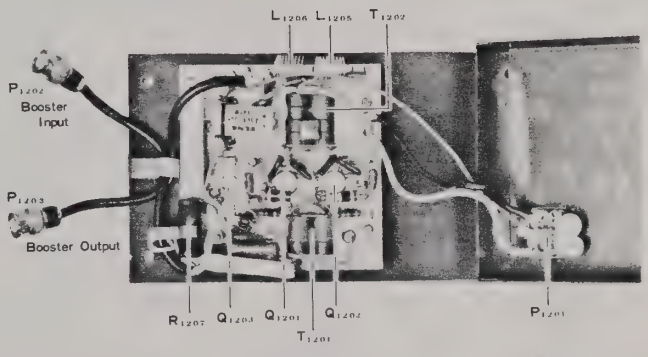


Figure 54 Booster Unit (PB-1444)

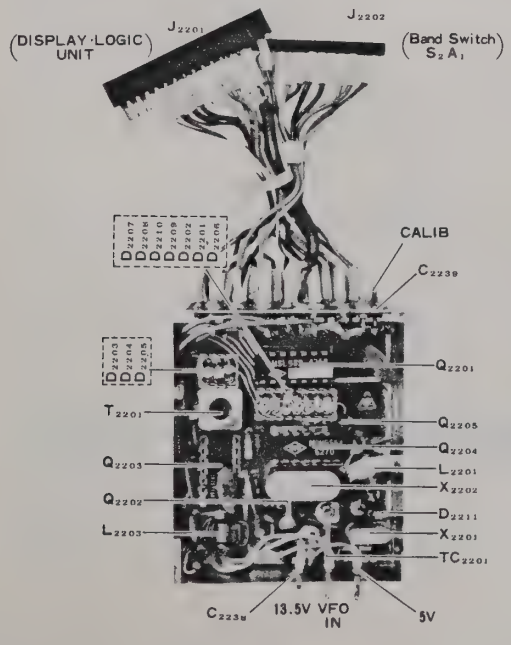


Figure 55 Counter-Mixer Unit (PB-1541)

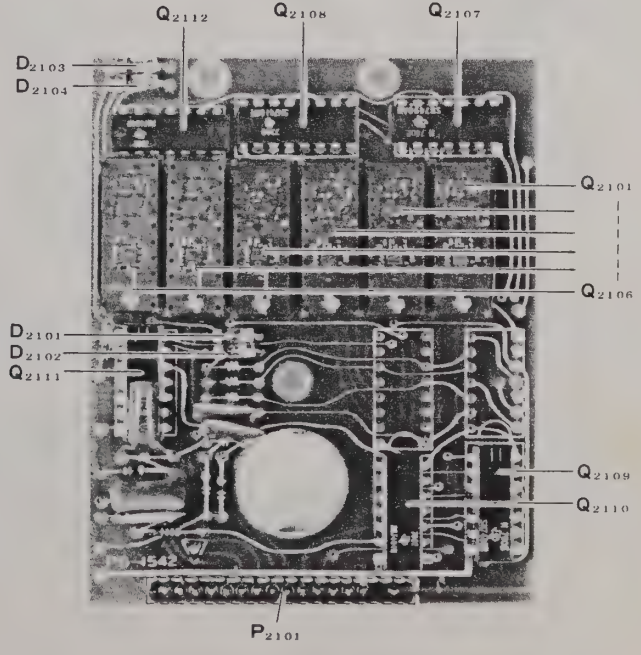


Figure 56 Display-Logic Unit (PB-1542)

L	INDUCTOR	
201	RF CHOKE	22μH

FILTER UNIT

PB	PRINTED CIRCUIT BOARD
1435(A～Z)	

Q	FET & TRANSISTOR	
302	FET	2SK19GR
303	Tr	2SC372Y
301	〃	2SC784R

D	DIODE	
301,303～306,310	Ge	1S1007
302,307	Si	1S1555
308	Zener	WZ110

XF	CRYSTAL FILTER	
301	9M-20A	
302	CW	XF-90C (OPTION)
303	AM	XF-90B (OPTION)
304	SSB	XF-92A

R	RESISTOR		
	CARBON FILM		
303	¼W		56Ω
304,312,315,316,323	〃		100Ω
306,308	〃		330Ω
305,327	〃		1KΩ
309,311	〃		2.2KΩ
313,320,321,322,326	〃		3.3KΩ
301,329	〃		6.8KΩ
307,310	〃		10KΩ
302	〃		39KΩ
	CARBON COMPOSITION		
328	½W		56Ω

VR	POTENTIOMETER	
301	V10K8-1-2	500ΩB

C	CAPACITOR		
	CERAMIC DISC		
302	50WV		33PF(CH)
307	〃		51PF(〃)
301,303,305,308～311 313～317,321～323,325	〃		0.01μF
304,312,318,319,324 326	〃		0.047μF
	ELECTROLYTIC		
306	16WV		10μF

L	INDUCTOR	
301	RF CHOKE	250μH
302～307	〃	150μH

T	TRANSFORMER	
301,303,304	R12-4170	#220140
302	R12-4171	#220141

IF UNIT

PB	PRINTED CIRCUIT BOARD
1436(A～Z)	

Q	IC, FET & TRANSISTOR	
407	IC	TA7089M
401	FET	3SK40M
403,409	〃	2SK19GR
404,405	Tr	2SC373
406,410	〃	2SC735Y
402	〃	2SC784R
408	〃	2SC1383

D	DIODE	
403	Ge	1S1007
401,405～408,410	Si	1S1555
402	Zener	BZ090
404,409	〃	WZ090

X	CRYSTAL	
401	HC-18/U8999.3kHz	

R	RESISTOR		
	CARBON FILM		
407,411,427	¼W		4.7Ω
423	〃		33Ω
424	〃		75Ω
415	〃		100Ω
405,436	〃		150Ω
410	〃		220Ω
430,435	〃		270Ω
417	〃		560Ω
414,422,425,429,433	〃		1KΩ
406	〃		1.8KΩ
437	〃		2.2KΩ
418	〃		2.7KΩ
431	〃		3.3KΩ
408,413,416	〃		4.7KΩ
412,426,434	〃		10KΩ
421	〃		24KΩ
409	〃		33KΩ
401,403,419,432	〃		100KΩ
420	〃		120KΩ
404	〃		150KΩ
402	〃		390KΩ

VR	POTENTIOMETER	
401,402	V10K8-1-2	1KΩB
403	〃	5KΩB

C	CAPACITOR		
	CERAMIC DISC		
408	50WV		10PF(CH)
414	〃		18PF(〃)
428	〃		39PF(〃)
421	〃		120PF(〃)
422	〃		270PF(〃)
401,417,423	〃		0.001μF
403,406,407,409～412 416,424,429,431,433	〃		0.01μF
404,405,413,415,419 420,429,430	〃		0.047μF
	MYLAR		
426,427	50WV		0.022μF
418	〃		0.1μF
	ELECTROLYTIC		
402,432	16WV		10μF
425	〃		100μF

TC	TRIMMER CAPACITOR		
401,402	ECV-1ZW	20×40	20PF

L	INDUCTOR	
403	RF CHOKE	22μH
401,402	〃	1mH

T	TRANSFORMER	
401	R12-4171	#220141
402	R12-4170	#220140

AF UNIT

PB	PRINTED CIRCUIT BOARD
1437(A～Z)	

Q	IC, FET & TRANSISTOR	
503	IC	LD3141
501	FET	2SK19GR
507	Tr	2SA695D
509	〃	2SB529D
502	〃	2SC372Y
506	〃	2SC711F
504,505	〃	2SC1000GR
508	〃	2SD359D

D	DIODE	
503～506	Ge	1S1007
501,502,507	Si	1S1555
508	〃	MV-5W
509,510	Zener	WZ090

X	CRYSTAL	
501	HC-18/U	9001.5kHz
502	〃	8998.5kHz

R	RESISTOR	
	CARBON FILM	
533	1/4W	10Ω
530	〃	22Ω
522	〃	56Ω
512	〃	100Ω
505,508,510,511	〃	150Ω
534	〃	180Ω
539,540	〃	220Ω
535	〃	270Ω
501～503,509,523,541	〃	470Ω
517,519,542	〃	1KΩ
526,528	〃	1.5KΩ
525	〃	2.2KΩ
524,538	〃	3.3KΩ
506,507,514,516	〃	4.7KΩ
518,532	〃	10KΩ
521	〃	15KΩ
527	〃	47KΩ
520	〃	56KΩ
504,529,531	〃	100KΩ
515	〃	390KΩ
	WIRE WOUND	
536,537	1/2W	0.22Ω

VR	POTENTIOMETER	
501	V10K8-1-2	500ΩB

C	CAPACITOR	
	DIPPED MICA	
530,536	50WV	330PF
	CERAMIC DISC	
516	50WV	10PF(CH)
509	〃	20PF(〃)
505,506	50WV	39PF(CH)
518	〃	100PF(〃)
507,508	〃	150PF(〃)
501,502,511～513,515		0.01μF
503,504,514,543		0.047μF
	MYLAR	
538,539	50WV	0.0022μF
526	〃	0.0047μF
528	〃	0.022μF
525,541,545	〃	0.047μF
544	〃	0.1μF
	ELECTROLYTIC	
519,524,529,532,534	16WV	1μF
523	〃	2.2μF
531	〃	4.7μF
527	〃	22μF
520～522,533	〃	33μF
534,542	16WV	100μF
537,540	〃	220μF

TC	TRIMMER CAPACITOR		
501,502	ECV-1ZW	20×40	20PF
503	ECV-1ZW	50×40	50PF

L	INDUCTOR	
504	RF CHOKE	22μH
506	〃	250μH
501～503,505	〃	1mH

T	TRANSFORMER	
501	R12-4171	#220141

RL	RELAY	
501	G2E	12V DC

VOX UNIT

PB	PRINTED CIRCUIT BOARD
1438(A～Z)	

Q	IC & TRANSISTOR	
604	IC	SN72560P
612	〃	34013(MC-14013CP)
607	Tr	2SA564A
605,608	〃	2SC372Y
601～603,606,609	〃	2SC373
610,611	〃	2SC735 Y

D	DIODE	
601～603,606	Ge	1N60FM
604,605	Zener	WZ090

X	CRYSTAL	
601	HC-13/UW	100kHz

R	RESISTOR	
	CARBON FILM	
633,637	1/4W	100Ω
603,613,621,638	〃	470Ω
606,607,611,614,619,628,639,641	〃	1KΩ
605	〃	2.2KΩ
629	〃	3.9KΩ
618,620,624～626,635	〃	4.7KΩ
612	〃	5.6KΩ
604,610,615,616,631	〃	10KΩ
602,617,622,627,636	〃	22KΩ
609	〃	39KΩ

608,630,640	¼W	47KΩ
601	〃	68KΩ
623,632	〃	100KΩ
	CARBON COMPOSITION	
634	½W	180Ω
VR	POTENTIOMETER	
603	V10K8-1-2	10KΩB
601	〃	50KΩB
602	〃	1MΩB
C	CAPACITOR	
	DIPPED MICA	
628	50WV	330PF
629	〃	2000PF
	CERAMIC DISC	
632	50WV	15PF(CH)
631	〃	33PF(〃)
634,635	〃	39PF(〃)
627	〃	82PF(〃)
614,636	〃	0.047μF
	MYLAR	
605,618	50WV	0.001μF
612,626	〃	0.01μF
621～623	〃	0.022μF
606,608	〃	0.047μF
	TANTALUM	
613	50WV	2.2μF
602,609	〃	10μF
	ELECTROLYTIC	
601,607,611,619	16WV	1μF
625	〃	2.2μF
624	〃	4.7μF
604,610,616,617,620	〃	10μF
603	〃	22μF
615	〃	47μF
630	〃	100μF
TC	TRIMMER CAPACITOR	
601	ECV-1ZW 50×40 50PF	
L	INDUCTOR	
601,602	RF CHOKE	4mH
SW	SWITCH	
601	SS-12-04	
	PREMIX UNIT	
PB	PRINTED CIRCUIT BOARD	
1439(A～Z)		
Q	IC, FET & TRANSISTOR	
701	IC	MC1496G
705	FET	2SK19GR
702	Tr	2SC372Y
703,704	〃	2SC784R
R	RESISTOR	
	CARBON FILM	
709	¼W	56Ω
704,711	〃	100Ω
716	〃	270Ω
721	〃	330Ω

714	¼W	470Ω
703,720	〃	560Ω
708	〃	820Ω
705～707	〃	1KΩ
712	〃	1.2KΩ
702	〃	3.3KΩ
710,711,713,718	〃	10KΩ
701	〃	15KΩ
715,719	〃	100KΩ
VR	POTENTIOMETER	
701	V10K8-1-2	50KΩB
C	CAPACITOR	
	DIPPED MICA	
702	50WV	39PF
	CERAMIC DISC	
716	50WV	8PF(CH)
703～707,709,712～714	〃	0.01μF
717,719		
701,708,710,711,715	〃	0.047μF
L	INDUCTOR	
703	RF CHOKE	250μH
701,702	〃	1mH
T	TRANSFORMER	
701		#220017
J	JACK	
701	SQ3056	
FB	FERRITE BEADS	
	4A-RI 3×3-1	
	VFO UNIT	
PB	PRINTED CIRCUIT BOARD	
1440(A～Z)		
Q	FET & TRANSISTOR	
802	FET	2SK19GR
801,803	Tr	2SC372Y
D	DIODE	
801	Varactor	1S2236
R	RESISTOR	
	CARBON FILM	
809,811	¼W	100Ω
807	〃	470Ω
805,808	〃	2.2KΩ
802	〃	3.3KΩ
801	〃	10KΩ
803	〃	18KΩ
804	〃	22KΩ
806,810	〃	100KΩ
C	CAPACITOR	
	DIPPED MICA	
826	50WV	2PF
807	〃	8PF
808,814,818	〃	33PF
811	〃	240PF
813,821,823	〃	470PF
802,822	〃	1000PF

CERAMIC DISC		
809,810,812,815,819 820,824,825	50WV	0.01μF

CERAMIC T. C		
801	50WV	4PF UJ
805	〃	9PF UJ
803	〃	20PF UJ
804,806	〃	20PF NPO

VC	VARIABLE CAPACITOR	
801	BS240DS114	

TC	TRIMMER CAPACITOR	
801	TSN 170C	
802	TSN 150C	

L	INDUCTOR	
801	Oscillator Coil	#220030
804,805	RF CHOKE	1.8μH
803,806	〃	250μH
802	〃	1mH

J	RECEPTACLE	
801	CN-3561	
802	CN-3965S	

CRYSTAL UNIT

PB	PRINTED CIRCUIT BOARD	
1441(A~Z)		

X	CRYSTAL		
901	(160m)	HC-25/U	16.0MHz
902	(40m)	〃	21.5MHz
903	(20m)	〃	28.5MHz
904	(15m)	〃	35.5MHz
905	(10mA)	〃	42.5MHz
906	(10mB)	〃	43.0MHz
907	(10mC)	〃	43.5MHz
908	(10mD)	〃	44.0MHz
909	(WWV/JJY)	〃	13998.5kHz
910	(11m)	〃	41.5MHz

XS	CRYSTAL SOCKET	
901	S-20	
902	S-19	

C	CAPACITOR	
	DIPPED MICA	
904	50WV	220PF
	CERAMIC DISC	
903	50WV	20PF(CH)
902	〃	82PF(〃)
901	〃	150PF(〃)

TC	TRIMMER CAPACITOR		
901~904,908,909	ECV-1ZW	50×32	50PF
905~907,910	ECV-1ZW	20×32	20PF

8PF UNIT

PB	PRINTED CIRCUIT BOARD	
1442(A~Z)		

R	RESISTOR	
1001,1007,1008	1/4W	10KΩ
1003~1006	〃	12KΩ
1002	〃	15KΩ

T	TRANSFORMER	
1001	(160m)	#220018
1002	(40m)	#220019
1003	(20m)	#220020
1004	(15m)	#220021
1005	(10m)	#220022
1006	(11m)	#220043

10W AMP UNIT

PB	PRINTED CIRCUIT BOARD	
1443(A~Z)		

Q	TRANSISTOR	
1101		2SC1589
1102,1103		S10-12

D	DIODE		
1102,1103		Si	10D10
1101		Zener	YZ33

R	RESISTOR		
	CARBON COMPOSITION		
1105		1/2W	4.7Ω
1107,1108		〃	15Ω
1103		〃	22Ω
1109		〃	39Ω
1110,1111		〃	100Ω
1101		〃	180Ω
1102		〃	330Ω
1106		〃	820Ω
1104		2W	82Ω

C	CAPACITOR		
	DIPPED MICA		
1110,1112		500WV	75PF
1111		〃	150PF
	CERAMIC DISC		
1109		500WV	0.001μF
1105		〃	0.007μF
1101,1108		〃	0.01μF
1102~1104,1113,1114		〃	0.047μF
	MYLAR		
1115,1116		50WV	0.2μF
	ELECTROLYTIC		
1117		50WV	1μF
1106,1107		16WV	33μF

L	INDUCTOR	
1101	RF CHOKE	#220031
1102	〃	#220032
1103,1104	Lowpass Coil	#220033

T	TRANSFORMER	
1101		#220023
1102		#220024

100W AMP UNIT

PB	PRINTED CIRCUIT BOARD	
1444(A~Z)		

Q	TRANSISTOR	
1201,1202		S-2535
1203		BY-1-1

R	RESISTOR		
	CARBON COMPOSITION		
1210	½W	2.2Ω	
1203,1205		15Ω	
	METALIC FILM		
1206,1207	½W	39Ω	
1202	2W	56Ω	
1201	5W	33Ω	
	CEMENT		
1208	10W	25Ω	
VR	POTENTIOMETER		
1201	EVW-R1AB 01B11	10Ω	
C	CAPACITOR		
	DIPPED MICA		
1214,1216	500WV	75PF	
1202	〃	82PF	
1215	〃	150PF	
1201	〃	430PF	
1209	〃	750PF	
1204,1205,1207,1208	〃	1000PF	
	CERAMIC DISC		
1217,1218	50WV	0.047μF	
1210,1213,1220	〃	0.1μF	
	ELECTROLYTIC		
1212	50WV	10μF	
1211	16WV	47μF	
1219	25WV	470μF	
L	INDUCTOR		
1201			#220034
1202			#220041
1205,1206			#220033
1203,1204			#220035
T	TRANSFORMER		
1201			#220025
1202			#220026
P	PLUG		
2,3		UG-88	
1201		QMS-AB6M	

LPF UNIT

PB	PRINTED CIRCUIT BOARD		
1445(A～Z)			
Q	TRANSISTOR		
1301		2SC735Y	
D	DIODE		
1301		Thyristor CW01B	
1302～1307		Si 1S1555	
R	RESISTOR		
	CARBON FILM		
1301	¼W	82Ω	
1302	〃	1KΩ	
1303	〃	10KΩ	
VR	POTENTIOMETER		
1301,1302	V10K8-1-2		10KΩB
C	CAPACITOR		
	DIPPED MICA		
1306	50WV		330PF
1312,1314	500WV		100PF
1315,1317	〃		150PF
1313	〃		180PF
1316,1318,1320	〃		300PF
1319,1321,1323	〃		620PF
1324,1326	〃		1000PF
1322	〃		1200PF
1325	〃		2000PF
	CERAMIC DISC		
1301～1305,1307～1311 1327,1328	50WV		0.01μF
TC	TRIMMER CAPACITOR		
1301	ECV-1ZW 10×32		10PF
L	INDUCTOR		
1301～1303	RF CHOKC		1mH
1304,1305	(15m)	#220036	
1306,1307	(20m)	#220037	
1308,1309	(40m)	#220038	
1310,1311	(80m)	#220039(#220103)	
1312,1313	(160m)	#220040(#220104)	
T	TRANSFORMER		
1301	CM Coupler	#220027	
RL	RELAY		
1301	UPM-12012H		

TRIMMER UNIT

PB	PRINTED CIRCUIT BOARD		
1446(A～Z)			
R	RESISTOR		
	CARBON FILM		
1401	¼W		10KΩ
C	CAPACITOR		
	DIPPED MICA		
1406,1410,1413	50WV		350PF
1402	〃		390PF
1401,1405,1409	〃		1000PF
	CERAMIC DISC		
1404,1408,1412	50WV		20PF(CH)
1403,1407,1411	〃		100PF(〃)
TC	TRIMMER CAPACITOR		
1412	ECV-1ZW 20×32		20PF
1404～1406,1410,1411 1416～1418	ECV-1ZW 50×32		50PF
1402,1403,1408,1409 1414,1415	B-2P-Y		100PF
1401,1407,1413	B-7P		420PF
T	TRANSFORMER		
1401	R12-4435		#220143

FIX UNIT

PB	PRINTED CIRCUIT BOARD

1447(A～Z)			
Q	FET & TRANSISTOR		
1501	FET	2SK19GR	
1502	Tr	2SC372Y	
X	CRYSTAL		
1501～1511	HC-25/U	(OPTION)	
XS	CRYSTAL SOCKET		
1501	S-14-12P		
R	RESISTOR		
	CARBON FILM		
1504	¼W		100Ω
1502	〃		180Ω
1501,1503	〃		100KΩ
C	CAPACITOR		
	DIPPED MICA		
1508,1510	50WV		470PF
1509	〃		820PF
	CERAMIC DISC		
1504	50WV		10PF(CH)
1511～1521	〃		15PF(〃)
1505	〃		100PF(〃)
1501	〃		150PF(〃)
1502	〃		270PF(〃)
1503,1506,1507	〃		0.01μF
TC	TRIMMER CAPACITOR		
1501～1511	ECV-1ZW 50×32		50PF
L	INDUCTOR		
1503,1504	RF CHOKE		1.8μH
1501	〃		22μH
1502	〃		1mH

VR UNIT

PB	PRINTED CIRCUIT BOARD		
1448(A～Z)			
D	DIODE		
1601	Zener	WZ090	
R	RESISTOR		
	CARBON FILM		
1601	¼W		470Ω
1602	〃		47KΩ
VR	POTENTIOMETER		
1601～1606		SR19R	47KΩB

SW UNIT

PB	PRINTED CIRCUIT BOARD		
1450(A～Z)			
C	CAPACITOR		
	TANTALUM		
1801	35WV		0.47μF
1802	〃		1.5μF
S	SWITCH		
1801,1805		SLE-14301	
1802,1804		SLE-12201	

BLANKING UNIT

PB	PRINTED CIRCUIT BOARD		
1451(A～Z)			
Q	ID & TRANSISTOR		
1901	IC	TP4011(MC14011)	
1902	Tr.	MPSA13	
D	DIODE		
1901	Si	1S1555	
R	RESISTOR		
	CARBON FILM		
1906	¼W		1KΩ
1904	〃		3.9KΩ
1905	〃		22KΩ
1907	〃		33KΩ
1903	〃		100KΩ
1901	〃		1MΩ
1902	〃		2MΩ
VR	POTENTIOMETER		
1901	SR-19R(D)		470ΩB
1902	SR-19R		470ΩB
C	CAPACITOR		
	MYLAR		
1901	50WV		0.1μF
RL	RELAY		
1901	G2E 12V DC		

AM UNIT

PB	PRINTED CIRCUIT BOARD		
1556(A～Z)			
Q	IC, FET & TRANSISTOR		
2003	IC	TA7120P	
2001,2005	FET	2SK19GR	
2002	〃	3SK40M	
2004,2006	Tr.	2SC372Y	
D	DIODE		
2006,2007	Ge	1N60FM	
2001～2003,2005 2008～2010	Si	1S1555	
2004	Zener	WZ090	
X	CRYSTAL		
2001	HC-18/U	8999.3kHz	#210015
R	RESISTOR		
	CARBON FILM		
2008,2014	¼W		100Ω
2003,2025	〃		150Ω
2016	〃		470Ω
2002,2019,2022	〃		1KΩ
2007	〃		1.2KΩ
2026,2027	〃		2.2KΩ
2009,2017,2021,2024	〃		3.3KΩ
2004,2006,2011	〃		4.7KΩ
2023	〃		5.6KΩ
2010	〃		10KΩ
2018	〃		15KΩ
2009,2020	〃		22KΩ
2013	〃		33KΩ
2015	〃		47KΩ

2012	1/4W	56KΩ
2001,2005	〃	100KΩ

VR	POTENTIOMETER	
2001,2002	V10K8-1 -2	5KΩB

C	CAPACITOR	
	CERAMIC DISC	
2002	50WV	27PF(CH)
2006	〃	33PF(〃)
2013,2014,2019,2028	〃	100PF(〃)
2009	〃	120PF(〃)
2004,2005	〃	150PF(〃)
2003,2007,2008,2010,2012 2020,2021	〃	0.01μF
2001,2022,2023,2029	〃	0.047μF
	MYLAR	
2027	50WV	0.0047μF
2011	〃	0.1μF
	ELECTROLYTIC	
2011,2024～2026	16WV	1μF
2015	〃	10μF
2017	〃	22μF
2016,2018	〃	100μF

TC	TRIMMER CAPACITOR	
2001,2002	ECV-1ZW 20×40	20PF

L	INDUCTOR	
2002	RF CHOKE	22μH
2001	〃	250μH #220100
2003	〃	1mH
2004	〃	4mH

DISPLAY LOGIC UNIT★

PB	PRINTED CIRCUIT BOARD
1542(A～Z)	

Q	IC	
2101～2103		TIL306
2104～2106		TIL308
2109,2111		SN7400N
2110,2112		SN7404N
2107		SN7490AN
2108		SN74160N

D	DIODE	
2101～2104	Ge	1N60AM

R	RESISTOR	
	CARBON COMPOSITION	
2101	1/8W	220Ω
2103,2106	〃	1KΩ
2102,2104,2105	〃	10KΩ

C	CAPACITOR	
	DIPPED MICA	
2102	50WV	200PF
2104,2105	〃	330PF
	CERAMIC DISC	
2101,2106	50WV	0.047μF
	MYLAR	
2103	50WV	0.0033μF

P	PIN PLUG	
2101	M-31-15-60-114P	

QS	IC SOCKET	
2101～2006	316-AG37D	

COUNTER MIXER UNIT★

PB	PRINTED CIRCUIT BOARD
1541(A～Z)	

Q	IC, FET & TRANSISTOR	
2201	IC	MSL980Y-2
2204	〃	MSM5564
2203	〃	SN76514
2202	FET	2SK19GR
2205	Tr	2SC373

D	DIODE	
2201～2210	Ge	1N60AM
2211	Varactor	1S2209

X	CRYSTAL		
2201	HC-18/U	18.5MHz	#210024
2202	HC-14/W	655.36kHz	#210025

R	RESISTOR	
	CARBON COMPOSITION	
2205	1/8W	1KΩ
	CARBON FILM	
2202,2203	1/4W	100Ω
2201	〃	180Ω
2207	〃	220Ω
2206	〃	22KΩ

VR	POTENTIOMETER		
2201	EVL-S3AA	00B14	10KΩB

C	CAPACITOR	
	DIPPED MICA	
2216,2217	50WV	51PF
	CERAMIC DISC	
2202	50WV	1PF(CH)
2203	〃	15PF(〃)
2208	〃	22PF(〃)
2204	〃	56PF(〃)
2205	〃	68PF(〃)
2206	〃	100PF(SL)
2201,2207,2213～2215	〃	0.01μF
2209～2212,2241	〃	0.047μF
	CERAMIC FEED TRHU	
2218～2240	ECK-YIH 102WE	0.001μF

TC	TRIMMER CAPACITOR	
2201	ECV-1ZW 20×53	20PF

L	INDUCTOR	
2201	RF CHOKE	250μH #220100
2202	〃	5.6μH #220145
2203	〃	35μH #220031
2204	〃	10μH

T	TRANSFORMER	
2201	T1005A	#220144

J	PIN PLUG, JACK	
2201	M-31-15-60-124S	

2202	M-31-15-60-114P	

LED UNIT

PB	PRINTED CIRCUIT BOARD	
1471(A～Z)		
D	DIODE	
2401	LED	TLR-108
R	RESISTOR	
	CARBON FILM	
2401	¼W	470Ω

LAMP BOARD A★

PB	PRINTED CIRCUIT BOARD	
1565(A～Z)		
Q	TRANSISTOR	
2301,2302		2SC536D
R	RESISTOR	
	CARBON COMPOSITION	
2301,2302	⅛W	10KΩ
PL	LAMP	
2301～2303	BQ041-32404A	12V 40mA

LAMP BOARD B

PB	PRINTED CIRCUIT BOARD	
1646(A～Z)		
Q	TRANSISTOR	
2501		2SC536D
R	RESISTOR	
	CARBON COMPOSITION	
2501	⅛W	10KΩ
PL	LAMP	
2501,2502	BQ041-32404A	12V 40mA